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Factors associated with breast MRI use among women with a family history of breast cancer

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Abstract

Although annual breast magnetic resonance imaging (MRI) is recommended for women at high risk for breast cancer as an adjunct to screening mammography, breast MRI use remains low. We examined factors associated with breast MRI use in a cohort of women with a family history of breast cancer but no personal cancer history. Study participants came from the Sister Study cohort, a nationwide, prospective study of women with at least one sister who had been diagnosed with breast cancer but who themselves had not ever had breast cancer (n=17,894). Participants were surveyed on breast cancer beliefs, cancer worry, breast MRI use, provider communication, and genetic counseling and testing. Logistic regression was used to assess factors associated with having a breast MRI overall and for those at high risk. Breast MRI was reported by 16.1% and was more common among younger women and those with higher incomes. After adjustment for demographics, ever use of breast MRI was associated with actual and perceived risk. Odds ratios (OR) were 12.29 (95% CI, 8.85–17.06), 2.48 (95% CI, 2.27–2.71) and 2.50 (95% CI, 2.09–2.99)

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for positive BRCA1/2 test, lifetime breast cancer risk ≥ 20%, and being told by a health care provider of higher risk, respectively. Women who believed they had much higher risk than others or had higher level of worry were twice as likely to have had breast MRI; OR=2.23 (95% CI, 1.82–2.75) and OR=1.76 (95% CI, 1.52–2.04). Patterns were similar among women at high risk. Breast cancer risk, provider communication and personal beliefs were determinants of breast MRI use. To support shared decisions about the use of breast MRI, women could benefit from improved understanding of the chances of getting breast cancer and increased quality of provider communications.

Keywords

cancer beliefs; provider communication; screening; breast MRI; family history

INTRODUCTION

Organizations such as the American Cancer Society (ACS) and the National Comprehensive Cancer Network (NCCN) recommend annual breast magnetic resonance imaging (MRI) for women at high risk for breast cancer as an adjunct to mammography for screening, including those with a strong family history or who are known or likely carriers of a *BRCA* mutation.[1–4] For women with known or suspected genetic mutations, the sensitivity of breast MRI with mammography is much higher than mammography alone.[5–7] However, research studies conducted after the 2007 ACS recommendation[1] have shown low use of breast MRI among women who might benefit from this test.[8–12]

This analysis examines factors associated with breast MRI use among a cohort of women who had a first-degree family history of breast cancer (sister). After excluding women who had a personal history of cancer, except non-melanoma skin cancer, we examined the relationship between ever having had a breast MRI and measures of breast cancer risk, sociodemographic characteristics, personal beliefs, and physician counseling.

MATERIALS AND METHODS

The Centers for Disease Control and Prevention (CDC) and the NIH's National Institute of Environmental Health Sciences (NIEHS), surveyed Sister Study participants on personal beliefs about breast cancer, cancer worry, breast MRI use, provider communication about familial breast cancer, genetic counseling and testing, and any available results of genetic testing. The Sister Study is a nationwide, prospective cohort study of women with at least one sister who had been diagnosed with breast cancer but who themselves had not ever had breast cancer. The Sister Study is described elsewhere (www.sisterstudy.niehs.nih.gov).[13,14] The cohort has modestly elevated average risk and is composed of participants with a wide range of risk levels. At enrollment, all Sister Study participants completed computer-assisted telephone interviews and self-administered questionnaires about medical and family history and demographic characteristics. Participants complete either an Annual Health Update or a comprehensive Triennial Follow-up Questionnaire every year. A special survey on the impact of breast cancer in families, breast cancer screening, and family communication about cancer was administered to Sister Study participants as a supplement to the Annual

Health Update. The study was approved by the Institutional Review Boards of the NIEHS/NIH and the Copernicus Group.

Population

In 2011–2012, 21,189 Sister Study participants who had not reported having breast cancer were scheduled to complete the Annual Health Update and received the special survey. A total of 19,540 eligible participants completed the survey (participation rate = 92.2%). Age was measured as of the date of completing the survey. Women were excluded from the current analysis if they had been diagnosed with any cancer prior to this survey (n=1367), had a history of lobular carcinoma in situ (n=30), had undergone a prophylactic mastectomy (n=78), or did not provide information on breast MRI (n=171), resulting in 17,894 participants.

MRI use

Women were given a brief description of a breast MRI and then asked if they had ever had one. For only the most recent breast MRI, women were asked the reasons and could select more than one reason. Choices included: “I had an abnormal mammogram”; ”I had a lump or other breast problem”; “My healthcare provider told me I was at high risk”; ”My family history of breast cancer”; “I have dense breasts”; or “I requested it”.

Breast cancer risk

The lifetime risk of invasive breast cancer was estimated at the time of initial study enrollment based on information collected on baseline questionnaires and the SAS macro for the Breast Cancer Risk Assessment Tool (BCRAT), also known as the Gail model, using the 2011 algorithm (http://www.cancer.gov/bcrisktool).[14] In its 2007 guidelines for screening with breast MRI,[1] the ACS refers to breast cancer risk-estimation models that are largely dependent on complex family history, such as BRCAPRO[15] and BOADICEA[16], to identify women with an approximately 20% to 25% or greater lifetime risk of breast cancer for breast MRI screening. Because we did not have sufficient family history information to generate risk estimates using these specialized models, we used risk estimates from the more commonly used BCRAT model.

Separate questions asked whether the participant or any family member related by blood had ever had a *BRCA1* or *BRCA2* genetic test. If yes, a follow up question asked whether the result indicated an increased risk for cancer.

For analyses of women grouped by risk, women were considered at high risk for breast cancer if one or more of the following criteria were met: lifetime breast cancer risk of 20% or greater; ever had a *BRCA1* or *BRCA2* genetic test with result indicating an increased risk; or two or more male or female first-degree relatives (parent, sibling or child) diagnosed with breast cancer. Among women identified as high risk using these criteria, 79% satisfied ≥1 criteria for referral to genetic counseling based on family history: known familial BRCA1/BRCA2 mutation; any family history of male breast cancer, at least one first or second degree relative diagnosed with breast cancer under age 45 years; 2 or more relatives

diagnosed with breast cancer at any age, on the same side of the family; at least one first or second degree relative diagnosed with ovarian cancer at any age.[17–19]

Provider counseling

Survey respondents were asked whether they had talked with a doctor about what their family history of breast cancer might mean for their own health and cancer risk. Respondents who answered yes were then asked if they had ever been told that they had a higher chance of getting breast cancer than other women of the same age. Responses to these two questions were combined to create a measure of communication: talked with doctor and was told of being at higher risk; talked with doctor and not told of being at higher risk; and did not talk with doctor about risk. Respondents also were asked if a doctor or other health professional had ever recommended genetic counseling because of their family history and if they had undergone genetic counseling.

Personal beliefs

Respondents were asked whether they perceived their lifetime risk of developing breast cancer to be much lower, lower, about the same, higher, or much higher than women their own age. They also reported that they strongly disagree, disagree, agree, or strongly agree with three statements related to worry about breast cancer and its effect on their lives: “I think about breast cancer more than most diseases”; “getting breast cancer is often in the back of my mind”; and “I am often bothered by thoughts or worry about my chances of getting breast cancer”. Responses were scored from 1 for strongly disagree to 4 for strongly agree. The Cronbach coefficient standardized alpha for the responses to these last three questions was 0.84, indicating high internal item consistency or item homogeneity.[20] Responses were summed to create a composite measure of worry that reflected the distribution of the total scores: least worry;(3–5) less worry;(6) more worry;(7–8) most worry.(9–12) Measures of worry were not calculated if responses to one or more of these four questions were missing (n=356).

Statistical analyses

Statistical analyses were performed with SAS, version 9.3. Logistic regression models were used to assess factors associated with ever or never having had a breast MRI for all participants and for women classified as at high risk, adjusted for demographic variables. The hotdeck method[21] as implemented in SUDAAN was used to impute missing values for income (n=646). Only age group and marital status were significant explanatory variables for missing income in a logistic regression and were used in the hotdeck procedure.

RESULTS

Overall, 16.1% (n=2,885) reported having ever had a breast MRI for any reason. The demographic factors most strongly associated with breast MRI use were younger age (< 50 years) and higher income (> $200,000) (Table 1). All measures of breast cancer risk were positively associated with breast MRI use, and having a positive personal *BRCA1* or *BRCA2* test was by far the strongest determinant. Women who had talked with a doctor about their family history were more likely to have had a breast MRI, and this relationship

was stronger for those who had been told they were at higher risk. Women who had received genetic counseling because of family history were much more likely to have received a breast MRI. Personal belief of being at higher risk and higher levels of worry also were associated with MRI use.

Using our criteria for high risk for breast cancer, 34% (n=6,078) of the women surveyed met one or more criteria. Of those, 88.8% had a BCRAT score of 20% or higher; 68.5% had two or more first degree relatives with breast cancer; and 2.3% had a positive *BRCA1* or *BRCA2* test result. Only 10% (n=616) of high-risk women met the criteria based only on the number of first-degree relatives with breast cancer. The proportion of women who reported ever having had a breast MRI was substantially higher among the high risk group compared to those not categorized as high risk (25.0% vs. 11.6%, $p < 0.01$).

Among the subset of women at high risk of breast cancer, the strongest associations with ever receiving a breast MRI were younger age, higher income, provider communication about family history and genetic counseling (Table 2). Perception of being at much higher risk of breast cancer and higher levels of worry also were associated with breast MRI use.

The reasons for the test were asked only for the most recent breast MRI. Although none of the survey respondents had been subsequently diagnosed with breast cancer, most (69%) selected an abnormal mammogram and/or lump or other breast problem as reasons for their most recent breast MRI; more than half (57.5%) reported an abnormal mammogram. About 1 in 5 women (21.3%) selected dense breasts as a reason for the most recent breast MRI, and 3.8% selected dense breasts as the only reason. Women at high risk were more likely to report family history of breast cancer and being told by a healthcare provider that they were high risk as reasons for the most recent breast MRI (Figure).

DISCUSSION

While the Sister Study cohort was sampled to have elevated risk, participants were breast-cancer-free at baseline and most do not meet the MRI guidelines based on risk cumulated over their remaining expected lifetime. In this survey of Sister Study participants with no personal history of cancer, 16% reported having had a breast MRI for any reason. Our study was conducted several years after the 2007 ACS guidelines for breast screening with MRI had been published, but only 25% of survey respondents classified as being at high risk of breast cancer had ever had a breast MRI for any reason. Although fairly low, these proportions were larger than the 4% and 10% reported among women at average and high risk of breast cancer, respectively, in the 2010 National Health Interview Survey,[8] perhaps reflecting the unique characteristics of this study population. In addition to having a sister with breast cancer, women in the Sister Study have, on average, higher levels of income, education and insurance coverage than the general population. This may be especially relevant for obtaining a breast MRI, a procedure that requires justification and payment with varying coverage for the procedure across insurance companies.

In this population of cancer-free women, women who were told by a doctor that they had a higher risk of breast cancer were substantially more likely to report ever having had a breast

MRI. These findings are consistent with those of a recent study reporting patients who received direct communications about their lifetime risk of breast cancer were more likely to receive adjunct breast MRI screening.[12] Women who perceived themselves at higher risk and those with higher worry levels also were more likely to have undergone breast MRI. All women in this survey had a sister with breast cancer, but other factors may contribute to perceived risk and screening decisions. For example, heightened perceived risk and worry could be related to emotional experiences with her sister's cancer, the number of relatives with cancer, and the intensity of those familial relationships.[22]

Among women not at high risk in this study, nearly 90% had never had a breast MRI, indicating little potential overuse. The most common reason reported for the most recent breast MRI was as an abnormal mammogram, regardless of whether or not a woman was at high risk of breast cancer. Women at high risk, however, were more likely to identify their family or personal risk among the reasons for their most recent breast MRI.

This study is limited by the brevity and cross-sectional nature of the survey and the fact that all responses were based on self-reports and therefore subject to error. We did not have medical documentation on the number or frequency of breast MRI tests or verification of the reasons for the tests. Since we only surveyed women without breast cancer, women whose breast cancer was diagnosed after a breast MRI were not included among the survey respondents, potentially leading to underestimates of breast MRI use. Women were asked reasons for only their most recent test and might not have fully understood the reason for the test.

Although family history of breast cancer was self-reported, reporting of family history is generally considered accurate for first degree relatives but possibly underreported for second degree relatives and paternal relatives.[23,24] In addition to clinical and reproductive factors, the BRCAT model uses first-degree family history to estimate breast cancer risk and is not equivalent to other models that depend more on detailed family history.[25] However, this study included women whose sisters had breast cancer, and more than three quarters of the high risk women in this study also met family history criteria for genetic counseling. Also, information on high-penetrance genetic factors like *BRCA1* and *BRCA2* was incomplete, as testing remained expensive and was not done as part of the study. It is possible that some women with genetic mutations may not have been tested and therefore may not have been included among the high risk women in this study.

Our study is the first to simultaneously examine the influence of breast cancer risk, provider communication and personal beliefs as determinants of the use of breast MRI among women with a family history of breast cancer, including a large number of women at increased breast cancer risk. These data suggest that women with a family history of breast cancer could benefit from an improved understanding of the chances of getting breast cancer and better communications with providers. Enhanced understanding and communications about risk could contribute to shared decision making about the use of breast MRI as an adjunct to mammography for the early detection of breast cancer.

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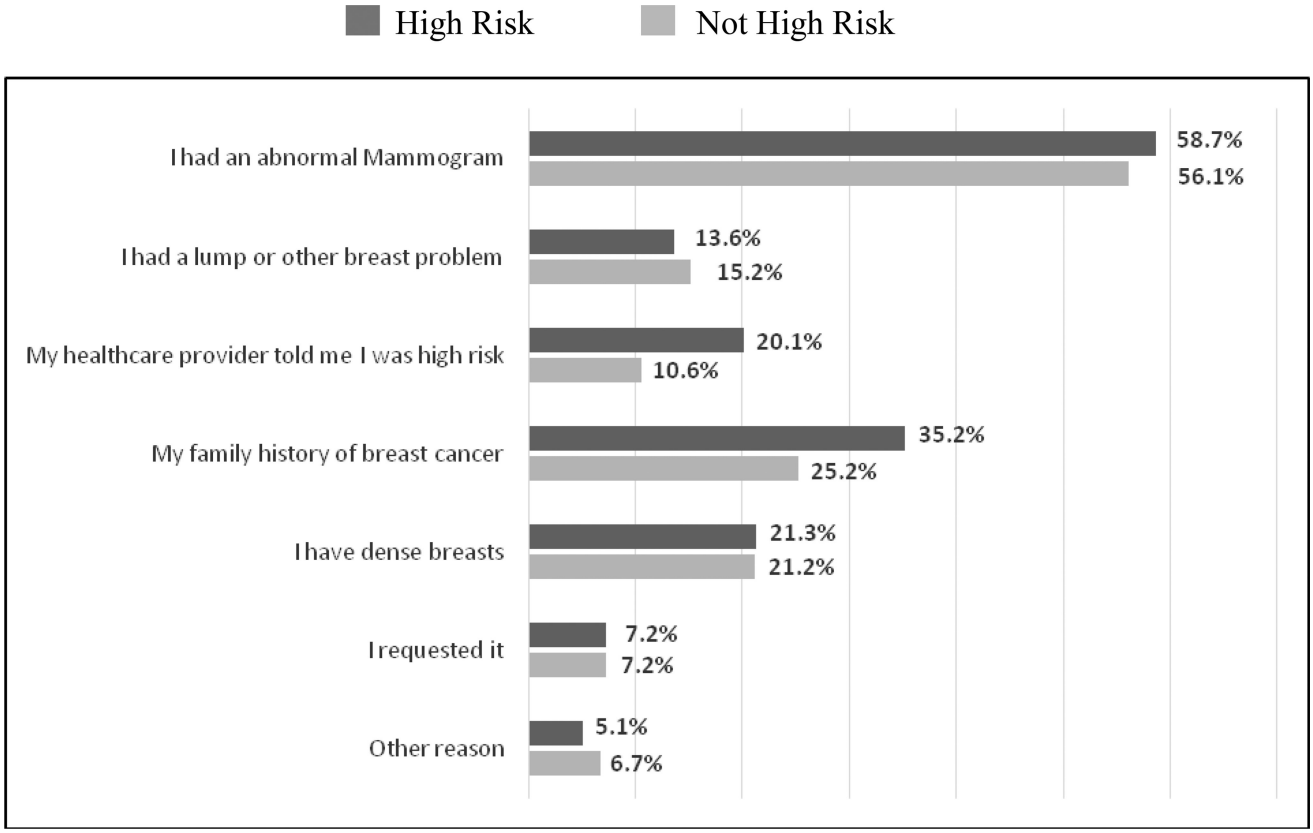

Figure.

Reasons for most recent breast MRI among the subset of Sister Study participants who had ever had a breast MRI, by breast cancer risk category.

High risk was defined as BCRAT>=20% or self BRCA1/2 positive or >=2 first degree relatives with breast cancer (n=1519); not high risk included all other respondents (n=1366). Respondents could select all that apply and categories are not mutually exclusive

Table 1

Odds ratios and 95% confidence intervals for breast MRI use among Sister Study participants by demographic characteristics and genetic risk, provider counseling, and personal beliefs

	Ever had breast MRI							
	Yes		No		Unadjusted		Adjusted	
	N	(%)	N	(%)	OR	95% CI	OR	95% CI
Demographic characteristics *								
Age								
38–49	673	(23.3)	2,072	(13.8)	3.34	(2.83, 3.95)	2.98	(2.50, 3.56)
50–59	1,188	(41.2)	5,378	(35.8)	2.27	(1.95, 2.65)	2.02	(1.71, 2.38)
60–69	815	(28.2)	5,410	(36.0)	1.55	(1.32, 1.82)	1.41	(1.19, 1.67)
70–80	209	(7.2)	2,149	(14.3)	1.0	*(Reference)*	1.0	*(Reference)*
Race								
Non-Hispanic white	2,368	(82.1)	12,405	(82.7)	1.0	*(Reference)*	1.0	*(Reference)*
Non-Hispanic black	293	(10.2)	1,565	(10.4)	0.98	(0.86, 1.12)	0.98	(0.85, 1.13)
Hispanic	145	(5.0)	676	(4.5)	1.12	(0.93, 1.35)	1.12	(0.92, 1.37)
All others	78	(2.7)	358	(2.4)	1.14	(0.89, 1.46)	1.11	(0.86, 1.44)
Highest Education								
High school or less	346	(12.0)	2,230	(14.9)	1.0	*(Reference)*	1.0	*(Reference)*
Some college/associate degree	848	(29.4)	5,021	(33.5)	1.09	(0.95, 1.25)	0.97	(0.84, 1.11)
Bachelor’s degree	874	(30.3)	4,124	(27.5)	1.37	(1.19, 1.56)	1.07	(0.93, 1.24)
Graduate degree	817	(28.3)	3,631	(24.2)	1.45	(1.27, 1.66)	1.17	(1.01, 1.36)
Marital Status								
Formerly married	439	(15.2)	3,009	(20.0)	1.0	*(Reference)*	1.0	*(Reference)*
Never married	158	(5.5)	815	(5.4)	1.33	(1.09, 1.62)	1.05	(0.86, 1.30)
Married	2,288	(79.3)	11,180	(74.5)	1.40	(1.26, 1.57)	1.06	(0.94, 1.21)
Income								
Less than $50,000	475	(16.5)	3,713	(24.7)	1.0	*(Reference)*	1.0	*(Reference)*
$50,000–$99,999	1,111	(38.5)	6,258	(41.7)	1.39	(1.24, 1.56)	1.21	(1.06, 1.37)
$100,000–$200,000	962	(33.3)	4,059	(27.0)	1.85	(1.65, 2.09)	1.48	(1.28, 1.71)
More than $200,000	337	(11.7)	977	(6.5)	2.70	(2.31, 3.15)	2.14	(1.79, 2.56)

	Ever had breast MRI							
	Yes		No		Unadjusted		Adjusted	
	N	(%)	N	(%)	OR	95% CI	OR	95% CI
Insurance								
No	100	(3.5)	570	(3.8)	1.0	*(Reference)*	1.0	*(Reference)*
Yes	2,666	(92.4)	13,878	(92.5)	1.10	(0.88, 1.36)	1.09	(0.87, 1.36)
Measures of breast cancer risk †								
BCRAT score								
Less than 20%	1,501	(52.0)	10,993	(73.2)	1.0	*(Reference)*	1.0	*(Reference)*
20% or greater	1,384	(48.0)	4,016	(26.8)	2.52	(2.33, 2.74)	2.48	(2.27, 2.71)
No. 1st degree relatives w. breast cancer								
Fewer than 2	1,860	(64.5)	11,867	(79.1)	1.0	*(Reference)*	1.0	*(Reference)*
2	873	(30.3)	2,813	(18.7)	1.98	(1.81, 2.17)	2.11	(1.92, 2.32)
3 to 6	152	(5.3)	328	(2.2)	2.96	(2.43, 3.61)	3.67	(2.98, 4.53)
BRCA1 or *BRCA2* test (self)								
Didn't have *BRCA* test	2,312	(80.1)	13,823	(92.1)	1.0	*(Reference)*	1.0	*(Reference)*
Don’t know if had test	76	(2.6)	344	(2.3)	1.32	(1.02, 1.70)	1.72	(1.35, 2.20)
Inconclusive/not increased risk	392	(13.6)	781	(5.2)	3.00	(2.64, 3.41)	2.73	(2.40, 2.45)
Increased risk	100	(3.5)	40	(0.3)	14.95	(10.33, 21.62)	12.29	(8.85, 17.06)
BRCA1 or *BRCA2* test (family)								
Didn't have *BRCA* test	1,058	(36.7)	6,707	(47.7)	1.0	*(Reference)*	1.0	*(Reference)*
Don’t know if had test	721	(25.0)	5,549	(37.0)	0.82	(0.75, 0.91)	0.87	(0.79, 0.97)
Inconclusive/Not increased risk	887	(30.7)	2,293	(15.3)	2.45	(2.22, 2.71)	2.20	(1.98, 2.45)
Increased risk	204	(7.1)	405	(2.7)	3.19	(2.67, 3.82)	3.07	(2.54, 3.69)
Provider Communication ≠								
Received genetic counseling because of family history								
No	2,209	(76.6)	14,079	(93.8)	1.0	*(Reference)*	1.0	*(Reference)*
Yes	675	(23.4)	909	(6.1)	4.73	(4.24, 5.28)	3.65	(3.25, 4.10)
Talked to doctor about family history of breast cancer								
Didn't talk to doctor	156	(5.4)	2,081	(13.9)	1.0	*(Reference)*		*(Reference)*
Talked and told not at higher chance of breast cancer	657	(22.8)	5,158	(34.4)	1.70	(1.42, 2.04)	1.37	(1.13, 1.65)
Talked and told at higher chance of getting breast cancer	2031	(70.4)	7459	(50.3)	3.59	(3.03, 4.25)	2.50	(2.09, 2.99)

	Ever had breast MRI							
	Yes		No		Unadjusted		Adjusted	
	N	(%)	N	(%)	OR	95% CI	OR	95% CI
Personal Beliefs [§]								
Compared to most women at same age, chances of getting breast cancer over lifetime								
Much lower or lower	185	(6.4)	1,507	(10.1)	1.0	*(Reference)*	1.0	*(Reference)*
About the same	692	(24.0)	5,210	(34.7)	1.08	(0.91, 1.29)	0.98	(0.81, 1.17)
Higher	1,453	(50.4)	6,926	(46.1)	1.71	(1.45, 2.01)	1.30	(1.09, 1.55)
Much higher	537	(18.6)	1,279	(8.5)	3.42	(2.85, 4.11)	2.23	(1.82, 2.75)
Worry								
Least	356	(12.3)	2,731	(18.2)	1.0	*(Reference)*		*(Reference)*
Less	626	(21.7)	4,498	(30.0)	1.07	(0.93, 1.23)	1.03	(0.89, 1.19)
More	984	(34.1)	4,591	(30.6)	1.64	(1.44, 1.87)	1.42	(1.24, 1.63)
Most	862	(29.9)	2,890	(19.3)	2.29	(2.00, 2.62)	1.76	(1.52, 2.04)

[*] Mutually adjusted for other demographic variables only.

[†] Multivariable model adjusts for demographic variables and does not adjust for other genetic risk, provider communication or personal belief variables.

[‡] Multivariable model adjusts for demographic and other provider communication variable and does not adjust for genetic risk or personal belief variables.

[§] Multivariable model adjusts for demographic and other personal belief variables and does not adjust for provider communication or breast cancer risk variables.

Table 2

Odds ratios and 95% confidence intervals for breast MRI use among Sister Study participants at high risk of breast cancer [*] by selected determinants

	Ever Had Breast MRI	
	OR	**95% CI**
Demographics[†]		
Age		
38–49	3.20	(2.43, 4.21)
50–59	2.17	(1.68, 2.80)
60–69	1.40	(1.08, 1.81)
70–80	1.0	*(Reference)*
Race		
Non-Hispanic White	1.0	*(Reference)*
Non-Hispanic Black	0.84	(0.63, 1.12)
Hispanic	1.23	(0.85, 1.79)
Other	1.01	(0.69, 1.46)
Education		
High school or less	1.0	*(Reference)*
Some college/associate degree	1.05	(0.85, 1.28)
Bachelor's degree	1.13	(0.92, 1.40)
Graduate degree	1.29	(1.04, 1.60)
Marital		
Divorced/separated/Widowed	1.0	*(Reference)*
Never married	1.27	(0.92, 1.74)
Legally married/living as married	1.13	(0.93, 1.37)
Income-Imputed		
Less than $50,000	1.0	*(Reference)*
$50,000–$99,999	1.20	(1.00, 1.46)
$100,000–$200,000	1.47	(1.19, 1.82)
More than $200,000	2.28	(2.28, 2.96)
Insurance		
No	1.0	*(Reference)*
Yes	0.92	(0.66, 1.28)
Provider Communication[‡]		
Received genetic counseling because of family history		
No	1.0	*(Reference)*
Yes	3.12	(2.68, 3.62)
Talked to doctor about family history breast cancer		
Didn't talk to doctor	1.0	*(Reference)*
Talked and not told at higher chance of getting breast cancer	1.72	(1.16, 2.56)
Talked and told at higher chance of getting breast cancer	3.02	(2.07, 4.34)
Personal beliefs[§]		

	Ever Had Breast MRI	
	OR	**95% CI**
Compared to most women at same age, chances of getting breast cancer over lifetime		
Much lower or lower	1.0	*(Reference)*
About the same	0.75	(0.55, 1.01)
Higher	0.97	(0.73, 1.29)
Much higher	1.80	(1.32, 2.44)
Composite worry score		
Least	1.0	*(Reference)*
Less	0.98	(0.79, 1.23)
More	1.26	(1.03, 1.56)
Most	1.42	(1.14, 1.77)

[*] High Risk defined as BCRAT>=20% or self *BRCA1/2* positive or >=2 first degree relatives with breast cancer.

[†] Mutually adjusted for other demographic variables only.

[‡] Multivariable model adjusts for demographic and other provider communication variable and does not adjust for personal belief variables.

[§] Multivariable model adjusts for demographic and other personal belief variable and does not adjust for provider communication variables.