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Original Research

Women's Experience With Screening Mammography During the COVID-19 Pandemic: A Multi-Institutional Prospective Survey Study

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Abstract

Objective: Evaluate women's anxiety and experience undergoing screening mammography during the COVID-19 pandemic.

Methods: An IRB-approved anonymous survey was administered to women receiving screening mammography across six sites in the U.S. and Singapore from October 7, 2020, to March 11, 2021. Using a 1–5 Likert scale, women rated their pre- and post-visit anxiety regarding having their mammogram during the COVID-19 pandemic, importance of observed COVID-19 precautions, and personal risk factors for breast cancer and severe COVID-19 illness. Post-visit change in anxiety was evaluated. Multivariable logistic regression was used to test associations of pre-visit anxiety with breast cancer and COVID-19 risk factors.

Results: In total, 1086 women completed the survey. Of these, 59% (630/1061) had >1 breast cancer risk factor; 27% (282/1060) had >1 COVID-19 risk factors. Forty-two percent (445/1065) experienced pre-visit anxiety. Pre-visit anxiety was independently associated with risk factors for severe COVID-19 (OR for >2 vs 0 risk factors: 2.04, 95% confidence interval [CI]: 1.11–3.76) and breast cancer (OR for >2 vs 0 risk factors: 1.71, 95% CI: 1.17–2.50), after adjusting for age and site. Twenty-six percent (272/1065) of women reported post-visit anxiety, an absolute 16% decrease from pre-visit anxiety (95% CI: 14%–19%, *P* < 0.001). Provider masking (941/1075, 88%) and physical distancing (861/1085, 79%) were rated as the most important precautions.

Conclusion: Pre-visit anxiety was associated with COVID-19 or breast cancer risk factors and declined significantly after screening mammography. Provider masking and physical distancing were rated the most important precautions implemented by imaging clinics.

Key words: screening mammography; breast cancer; COVID-19.

Key Messages
- As the pandemic continues with the potential threat of new variants that may not be covered by current COVID-19 vaccinations, our results demonstrate that anxiety during screening mammography visits was frequently reported and was associated with COVID-19 or breast cancer risk factors.
- Women undergoing screening mammography said that the most important pandemic precautions included provider masking, physical distancing, signs indicating rooms are clean, and seeing staff clean their hands.

Introduction

The coronavirus disease 2019 (COVID-19) pandemic has disrupted healthcare on a worldwide scale with tremendous strain on healthcare delivery. Radiology examination volumes decreased by 40%–90% because of government and hospital mandates to curtail nonurgent and elective care (1–5). This reduction in imaging services had a large impact on breast imaging facilities in particular. On March 26, 2020, the American Society of Breast Surgeons and American College of Radiology recommended all screening mammography be postponed effective immediately (6). On April 30, 2020, the Society of Breast Imaging issued recommendations for best practices for returning to routine care once local and state mandates were lifted (7). While these local and state mandates were highly variable, all six of our institutions were at least temporarily closed for routine screening. This is in keeping with a recent survey by the Breast Cancer Surveillance Consortium, which revealed that 97% of surveyed United States breast imaging facilities were temporarily closed or operated at reduced capacity between March 2020 and September 2020 (8).

While much of the focus has been on COVID-19 pathophysiology and treatment, there are significant downstream effects of the pandemic that may not be realized until months or years from now. One such example is the delay of non-coronavirus-related medical care. In a poll by the Kaiser Family Fund conducted in May 2020, 48% of respondents reported skipping or postponing medical care because of the COVID-19 pandemic (9). While the long-term impact of the interruption of cancer screening during the COVID-19 pandemic is yet to unfold, Yong et al used a validated mathematical model to estimate the long-term impact on screening interruptions in Canada and found a three-month interruption could increase cases diagnosed at advanced stages (310 more) and cancer deaths (110 more) in 2020–2029 (10). Initial data from an Italian study found a significant increase in node-positive and stage III breast cancer after a two-month cessation of screening in 2020 (11). A recent collaborative simulation modeling study estimated excess U.S. breast cancer deaths of 0.52% over those expected by 2030 in the absence of the pandemic, suggesting that initial

pandemic-related disruptions in breast cancer care may have a small long-term cumulative impact on breast cancer mortality (12). However, continued efforts to ensure women continue routine screening mammograms during the ongoing pandemic are needed to mitigate subsequent pandemic-associated disruptions and delayed breast cancer detection.

In 2020, as facilities began implementing plans to support a safe return to mammography screening, it became apparent that including women's perspectives on resuming screening would supplement and strengthen facility-level considerations. Our study team developed a prospective multicenter survey study to evaluate women's experience with obtaining screening mammography during the reopening phase of the COVID-19 pandemic. We hypothesized that women's decisions to return to mammography screening would be mediated by their perceptions of three important domains: individual level risk of contracting COVID-19, risk of developing breast cancer, and anxiety level. Our goal was to better understand women's experiences to help prioritize interventions to reduce patient anxiety and identify which precautionary interventions and factors were most important to women.

Methods

Institutional review board approval was obtained for this Health Insurance Portability and Accountability Act–complaint prospective survey study performed at six sites in two countries, one in Singapore and five in the United States. Five of the sites are urban academic medical centers, and one is a rural academic medical center (13). Three of the institutions administered the survey at a single screening facility, whereas three have multiple screening facilities that each distributed surveys. The six participating institutions shared an interest in better understanding women's experiences and supporting their return to screening. The safeguards and practices described in the survey were offered across the participating institutions, with specific precautions implemented at the discretion of each clinic. An anonymous 19-question mixed-mode survey was offered to women after receiving screening mammography between October 7, 2020, and March 11, 2021. Patient eligibility included adult women who presented for a screening mammogram. Patients presenting for diagnostic breast imaging, screening breast US, breast MRI, or biopsy procedures were not included in the study. At two institutions, patients who presented for same-day combined screening (ie, mammography plus breast US or MRI) were offered surveys after the screening mammogram.

At the end of their screening mammogram appointments, women were offered the opportunity to participate in the survey study by clinic staff using either electronic (QR code access) and/or paper format. In clinics offering the digital version of the survey, QR codes were posted in dressing rooms, waiting areas, or imaging suites to minimize direct contact with study materials, with staff encouraged to call attention

to the survey. The QR code linked directly to a Research Electronic Data Capture (REDCap) survey, a secure web application for building and managing online surveys and databases (14,15). Paper format was entered manually by institutional research teams into REDCap. Electronic survey form submission or oral consent for paper surveys in lieu of written consent was approved by the institutional review board. Study data were collected using REDCap tools hosted at Mayo Clinic Arizona. REDCap provides (1) an intuitive interface for validated data capture; (2) audit trails for tracking data manipulation and export procedures; (3) automated export procedures for seamless data downloads to common statistical packages; and (4) procedures for data integration and interoperability with external sources.

The survey tool captured demographic data including age, race/ethnicity, level of education, number of screening mammograms within the preceding three years, self-reported breast cancer–associated risk factors, and severe COVID-19–associated risk factors as reported by the Centers for Disease Control and Prevention (CDC) (16). Women were also asked to rank (Likert scale, 1–5) their pre- and post-visit anxiety regarding having their mammogram during the COVID-19 pandemic. Additionally, women were asked to rank their personal focus on protecting themselves from COVID-19 including distancing, masks, and cleaning, as well as the level of importance of various COVID-19–related precautions observed during their appointment (Supplementary Figure S1).

Sample Size

Formal sample size calculations were not performed to choose a sample size, but a total sample size of 1800 was initially targeted (300 per site on average) to facilitate subgroup analyses. In March 2021, after 6 months of enrollment, the survey closed after receiving 1086 responses (60% of the targeted sample). At that time, the declining incidence of COVID-19 cases and increasing availability of COVID-19 vaccines in the United States indicated that the pandemic had likely reached a phase of continued decline, and the study team decided to close the survey. This decision was made prior to any statistical analysis of the data.

Statistical Analysis

Survey responses were summarized using standard descriptive statistics. Across participating sites, to minimize disruption of workflows, clinic staff were not required to confirm the number of eligible women who were offered the survey. Thus, the survey response rate was not calculated. Item-specific nonresponse was very limited, so respondents with missing values for individual responses were simply excluded from summaries involving those variables. Pre-visit anxiety was defined as self-reported anxiety level greater than "not anxious at all" (2 or above on 1–5 Likert scale). The change between pre- and post-visit anxiety was tested and compared between groups using Wald tests. Multivariable logistic regression was used to evaluate and

test associations of pre-visit anxiety with risk factors, race, age, and site. Throughout the analysis, *P*-values of < 0.05 were considered significant. All statistical calculations were conducted with the statistical computing language R (version 4.0.3; R Foundation for Statistical Computing, Vienna, Austria).

Results

Survey Responses

Demographics

Between October 7, 2020, and March 11, 2021, 1086 women completed the survey. Site was not available for two women. These women were included in overall summaries but not site-specific summaries. Item-specific nonresponse was ≤2.5% throughout the survey, with the highest rate of nonresponse being about race or ethnicity (27/1086, 2.5%). Respondents by site ranged from 134 to 242 (mean: 181 per site; Table 1). The median age was 56 years (range 29–84 years). Across all sites, 68% of women were White (721/1059). At one site, Singapore General Hospital, 99% (133/134) of women were of Asian race. Among the U.S. sites, 12% (107/923) of women were Black, 3% (30/923) were Hispanic or Latina, and 3% (29/923) were Asian. Among all sites, 59% (628/1061) of women had at least one self-reported risk factor for breast cancer, with self-reported dense breast tissue being the most frequent (409/1061, 39%); 27% (282/1060) of women had at least one risk factor for severe COVID-19 illness, with obesity being the most frequent (187/1060, 18%) (Table 2). There was no statistically significant association between the number of risk factors for breast cancer (*P* = 0.64) or specific breast cancer risk factors (*P* = 0.12) and the number of risk factors for severe COVID-19 illness (Supplementary Table S1).

Pre-visit Anxiety

Of the 1065 women who rated both their pre-visit and post-visit anxiety levels regarding having a mammogram during COVID-19 pandemic, 445 (42%) of women reported being at least "slightly anxious" on the pre-visit anxiety question (Table 3). The majority of women (620/1065, 58%) reported no anxiety, with the lowest proportion of women reporting no anxiety at Johns Hopkins University (102/212, 48%) and the highest proportion at University of Vermont (110/164, 67%). There was a small proportion of women who were very anxious (25/1065, 2%), with the most women feeling very anxious from Singapore General Hospital (6/128, 5%).

Multivariable analysis demonstrated that pre-visit anxiety was independently associated with the number of risk factors for severe COVID-19 illness (odds ratio [OR] for >2 vs 0 risk factors: 2.04, 95% CI: 1.11–3.76) and breast cancer (OR for >2 vs 0 risk factors: 1.71, 95% CI: 1.17–2.50) after adjusting for age and site (Table 4). Both age (OR = 0.88 per 10-year increase, 95% CI: 0.78–0.999, *P* = 0.049) and site (*P* = 0.012) were significantly associated with pre-visit anxiety in the same model.

Table 1. Respondent Demographics by Site (*N* = 1086)

		Site[a]					
Variable	**All Sites** (*N* = 1086) *n* (%)	**Emory University** (*N* = 162) *n* (%)	**Johns Hopkins University** (*N* = 213) *n* (%)	**Mayo Clinic in Arizona** (*N* = 242) *n* (%)	**Singapore General Hospital** (*N* = 134) *n* (%)	**University of Vermont** (*N* = 166) *n* (%)	**University of Washington** (*N* = 167) *n* (%)
Age	56 (29–84)	57 (35–82)	56 (29–81)	57 (31–81)	59 (35–80)	57 (34–84)	52 (31–78)
<40 years	19 (2%)	2 (1%)	7 (3%)	2 (1%)	3 (2%)	1 (1%)	4 (2%)
40–49 years	280 (26%)	42 (27%)	51 (24%)	57 (24%)	29 (22%)	41 (25%)	60 (36%)
50–59 years	357 (34%)	46 (29%)	74 (35%)	77 (32%)	40 (30%)	60 (37%)	58 (35%)
60–69 years	296 (28%)	52 (33%)	56 (27%)	76 (32%)	38 (29%)	44 (27%)	30 (18%)
≥70 years	113 (11%)	14 (9%)	22 (10%)	25 (11%)	22 (17%)	17 (10%)	13 (8%)
Race/ethnicity							
White	721 (68%)	89 (58%)	151 (73%)	189 (80%)	0 (0%)	158 (98%)	132 (80%)
Black/African American	107 (10%)	58 (38%)	35 (17%)	12 (5%)	0 (0%)	0 (0%)	2 (1%)
Hispanic or Latina or Spanish Origin	30 (3%)	3 (2%)	7 (3%)	14 (6%)	0 (0%)	0 (0%)	6 (4%)
Asian	162 (15%)	1 (1%)	6 (3%)	8 (3%)	133 (99%)	0 (0%)	14 (9%)
Native American/ Alaska Native	2 (<1%)	0 (0%)	0 (0%)	1 (<1%)	0 (0%)	0 (0%)	1 (1%)
Native Hawaiian/ Other Pacific Islander	2 (<1%)	0 (0%)	0 (0%)	1 (<1%)	0 (0%)	0 (0%)	1 (1%)
Multiple races	30 (3%)	2 (1%)	5 (2%)	11 (5%)	1 (1%)	4 (2%)	7 (4%)
Other	5 (<1%)	1 (1%)	2 (1%)	1 (<1%)	0 (0%)	0 (0%)	1 (1%)
Education							
Some high school	28 (3%)	0 (0%)	0 (0%)	0 (0%)	27 (20%)	0 (0%)	1 (1%)
Completed high school	74 (7%)	5 (3%)	8 (4%)	6 (3%)	36 (27%)	14 (9%)	5 (3%)
Completed some college or technical school	231 (21%)	26 (16%)	29 (14%)	72 (30%)	27 (20%)	43 (26%)	34 (20%)
Completed bachelor's degree	367 (34%)	47 (30%)	76 (36%)	85 (36%)	38 (28%)	50 (30%)	69 (42%)
Completed master's degree	275 (26%)	53 (33%)	73 (34%)	58 (24%)	6 (4%)	49 (30%)	36 (22%)
Completed doctoral degree	101 (9%)	28 (18%)	26 (12%)	18 (8%)	0 (0%)	8 (5%)	21 (13%)

[a]Two respondents did not have a site recorded; they are included in the All Sites summaries but not the site-specific summaries.

Among the respondents from U.S. cities (*N* = 891 after excluding those missing site, race, risk factors, and pre-visit anxiety), there was no significant association between pre-visit anxiety and women's race or ethnicity (Black/African American vs White: OR 0.92, 95% CI: 0.57–1.49, *P* = 0.74; all other races [Hispanic or Latina or Spanish origin, Asian, Native American/Alaska Native, Native Hawaiian/other Pacific Islander, multiple races or other] vs White: OR 0.99, 95% CI 0.62–1.58, *P* = 0.96) after adjusting for site, age, and risk factors for breast cancer or COVID-19.

Women reported the highest concern with cleanliness of the facility (77/1071, 7%) compared with availability of masks and gloves (59/1070, 6%), getting sick from other patients (42/1083, 4%), and getting sick from healthcare staff (30/1074, 3%) (Figure 1).

Change in Patient Anxiety
Of the 1065 women who rated both their pre- and post-visit anxiety, 272 women (26%) reported being at least "slightly anxious" on the post-visit anxiety question, an absolute

Table 2. Respondent Self-reported Risk Factors for Breast Cancer and Severe COVID-19 Infection by Site (*N* = 1086)

		Site[a]					
Variable	**All Sites** **(*N* = 1086)** **n (%)**	**Emory University** **(*N* = 162)** **n (%)**	**Johns Hopkins University** **(*N* = 213)** **n (%)**	**Mayo Clinic in Arizona** **(*N* = 242)** **n (%)**	**Singapore General Hospital** **(*N* = 134)** **n (%)**	**University of Vermont** **(*N* = 166)** **n (%)**	**University of Washington** **(*N* = 167)** **n (%)**
Self-reported risk factors for breast cancer							
Dense breast tissue	409 (39%)	49 (32%)	101 (49%)	102 (43%)	4 (3%)	71 (43%)	80 (48%)
Breast cancer gene mutation	7 (1%)	1 (1%)	2 (1%)	0 (0%)	0 (0%)	3 (2%)	1 (1%)
Personal history of breast cancer	122 (11%)	15 (10%)	16 (8%)	1 (<1%)	47 (35%)	11 (7%)	32 (19%)
First-degree relative with breast cancer	235 (22%)	25 (16%)	44 (21%)	49 (21%)	27 (20%)	45 (27%)	43 (26%)
Atypical cells seen on prior biopsy	35 (3%)	4 (3%)	6 (3%)	7 (3%)	1 (1%)	4 (2%)	13 (8%)
Prior history of chest radiation	21 (2%)	4 (3%)	6 (3%)	2 (1%)	1 (1%)	2 (1%)	6 (4%)
None	433 (41%)	84 (55%)	73 (35%)	105 (45%)	60 (45%)	66 (40%)	45 (27%)
≥1 risk factor)	628 (59%)	70 (45%)	134 (65%)	130 (55%)	73 (55%)	98 (60%)	121 (73%)
Risk factors for COVID-19 severe illness							
Obesity (BMI > 30)	187 (18%)	27 (17%)	46 (22%)	46 (19%)	5 (4%)	28 (17%)	35 (21%)
Diabetes	65 (6%)	12 (8%)	9 (4%)	16 (7%)	14 (11%)	7 (4%)	7 (4%)
COPD	13 (1%)	0 (0%)	6 (3%)	4 (2%)	1 (1%)	0 (0%)	2 (1%)
Weakened immune system after transplant	52 (5%)	12 (8%)	13 (6%)	6 (3%)	3 (2%)	3 (2%)	15 (9%)
Serious heart condition	18 (2%)	4 (3%)	3 (1%)	2 (1%)	4 (3%)	0 (0%)	5 (3%)
Sickle-cell disease	1 (<1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1%)
None	778 (73%)	110 (71%)	146 (71%)	174 (74%)	107 (83%)	132 (80%)	107 (65%)
≥1 risk factor	282 (27%)	45 (29%)	61 (29%)	62 (26%)	22 (17%)	34 (20%)	58 (35%)
Focus on protecting myself from COVID-19 (distancing, masks, cleaning)							
Strongly agree	929 (86%)	145 (91%)	197 (92%)	201 (84%)	98 (73%)	141 (85%)	145 (87%)
Agree	113 (10%)	12 (8%)	13 (6%)	25 (10%)	28 (21%)	20 (12%)	15 (9%)
Neutral	26 (2%)	2 (1%)	3 (1%)	8 (3%)	7 (5%)	1 (1%)	5 (3%)
Disagree	3 (<1%)	0 (0%)	0 (0%)	2 (1%)	1 (1%)	0 (0%)	0 (0%)
Strongly disagree	9 (1%)	0 (0%)	0 (0%)	3 (1%)	0 (0%)	4 (2%)	2 (1%)
Screening mammograms in last 3 years							
0	86 (8%)	5 (3%)	17 (8%)	15 (6%)	8 (6%)	19 (12%)	22 (13%)
1	125 (12%)	14 (9%)	24 (11%)	27 (11%)	27 (20%)	13 (8%)	20 (12%)
2	230 (21%)	36 (23%)	39 (18%)	40 (17%)	48 (36%)	35 (21%)	32 (19%)
3	620 (58%)	98 (62%)	131 (62%)	151 (63%)	49 (37%)	97 (59%)	92 (55%)
Can't remember	16 (1%)	5 (3%)	2 (1%)	6 (3%)	2 (1%)	1 (1%)	0 (0%)

Abbreviations: BMI, body mass index; COPD, chronic obstructive pulmonary disease; COVID-19, coronavirus disease 2019.
[a]Two respondents did not have a site recorded; they are included in the All Sites summaries but not the site-specific summaries.

Table 3. Respondent Ratings of Pre- and Post-visit Anxiety by Site (*N* = 1065 With Pre- and Post-appointment Anxiety Ratings)

		Site[a]					
Variable	**All Sites** (*N* = 1065) *n* (%)	**Emory University** (*N* = 157) *n* (%)	**Johns Hopkins University** (*N* = 212) *n* (%)	**Mayo Clinic in Arizona** (*N* = 239) *n* (%)	**Singapore General Hospital** (*N* = 128) *n* (%)	**University of Vermont** (*N* = 164) *n* (%)	**University of Washington** (*N* = 163) *n* (%)
Anxiety prior to appointment							
Very anxious	25 (2%)	3 (2%)	8 (4%)	5 (2%)	6 (5%)	1 (1%)	2 (1%)
Fairly anxious	52 (5%)	10 (6%)	8 (4%)	7 (3%)	10 (8%)	4 (2%)	13 (8%)
Somewhat anxious	134 (13%)	23 (15%)	36 (17%)	21 (9%)	10 (8%)	18 (11%)	26 (16%)
Slightly anxious	234 (22%)	33 (21%)	58 (27%)	54 (23%)	23 (18%)	31 (19%)	35 (21%)
Not anxious at all	620 (58%)	88 (56%)	102 (48%)	152 (64%)	79 (62%)	110 (67%)	87 (53%)
Anxiety after appointment							
Very anxious	13 (1%)	3 (2%)	2 (1%)	1 (<1%)	3 (2%)	1 (1%)	3 (2%)
Fairly anxious	24 (2%)	3 (2%)	2 (1%)	6 (3%)	10 (8%)	1 (1%)	2 (1%)
Somewhat anxious	47 (4%)	4 (3%)	16 (8%)	10 (4%)	2 (2%)	5 (3%)	10 (6%)
Slightly anxious	188 (18%)	29 (18%)	43 (20%)	32 (13%)	23 (18%)	25 (15%)	36 (22%)
Not anxious at all	793 (74%)	118 (75%)	149 (70%)	190 (79%)	90 (70%)	132 (80%)	112 (69%)

[a]Two respondents did not have a site recorded; they are included in the All Sites summaries but not the site-specific summaries.

Table 4. Multivariable Analysis of Pre-appointment Anxiety (Rating ≥ Slightly Anxious) as a Function of Risk Factors for Breast Cancer and Severe COVID-19 Illness (*N* = 1024 Without Missing Values)

		Multivariable Model		
Variable	**N**	**OR**	**(95% CI)**	**P-value**
Number of risk factors for breast cancer				0.019
0	415	(ref)		
1	447	1.11	(0.84–1.48)	
2+	162	1.71	(1.17–2.50)	
Number of risk factors for severe COVID-19 illness				0.034
0	758	(ref)		
1	220	1.27	(0.93–1.74)	
2+	46	2.04	(1.11–3.76)	
Age, per 10-year increase	-	0.88	(0.78–0.999)	0.049
Site				0.012
Emory University	151	1.59	(0.99–2.54)	
Johns Hopkins University	200	2.15	(1.39–3.33)	
Mayo Clinic in Arizona	231	1.21	(0.79–1.87)	
Singapore General Hospital	121	1.38	(0.84–2.29)	
University of Vermont[a]	160	(ref)		
University of Washington	161	1.63	(1.03–2.59)	

Abbreviations: CI, confidence interval; OR, odds ratio.
[a]University of Vermont chosen as reference since it had the lowest anxiety.

16% decrease in anxiety relative to the corresponding pre-visit anxiety question (95% CI: 14%–19%, *P* < 0.001). The decrease in patient anxiety was significant in both the first half of our survey time period (October–December 2020; *N* = 621; 14% decrease; 95% CI: 10%–17%, *P* < 0.001) and the second half (January–March 2021; *N* = 444; 20% decrease; 95% CI: 15%–24%, *P* < 0.001). The magnitude of the decrease in anxiety was statistically significant different between the two periods (14% vs 20%, *P* = 0.043).

Women's Perceptions Regarding Precautionary Interventions

The COVID-19 precautions ranked very important (Figure 2), in decreasing order, were: masking (941/1075, 88%), institution reputation (906/1077, 84%), physical distancing (861/1085, 79%), signs that the rooms/equipment was clean (851/1073, 79%), seeing staff clean hands (783/1075, 73%), pre-visit symptom screening (676/1078, 63%), temperature screening (616/1070, 58%), pre-visit information regarding
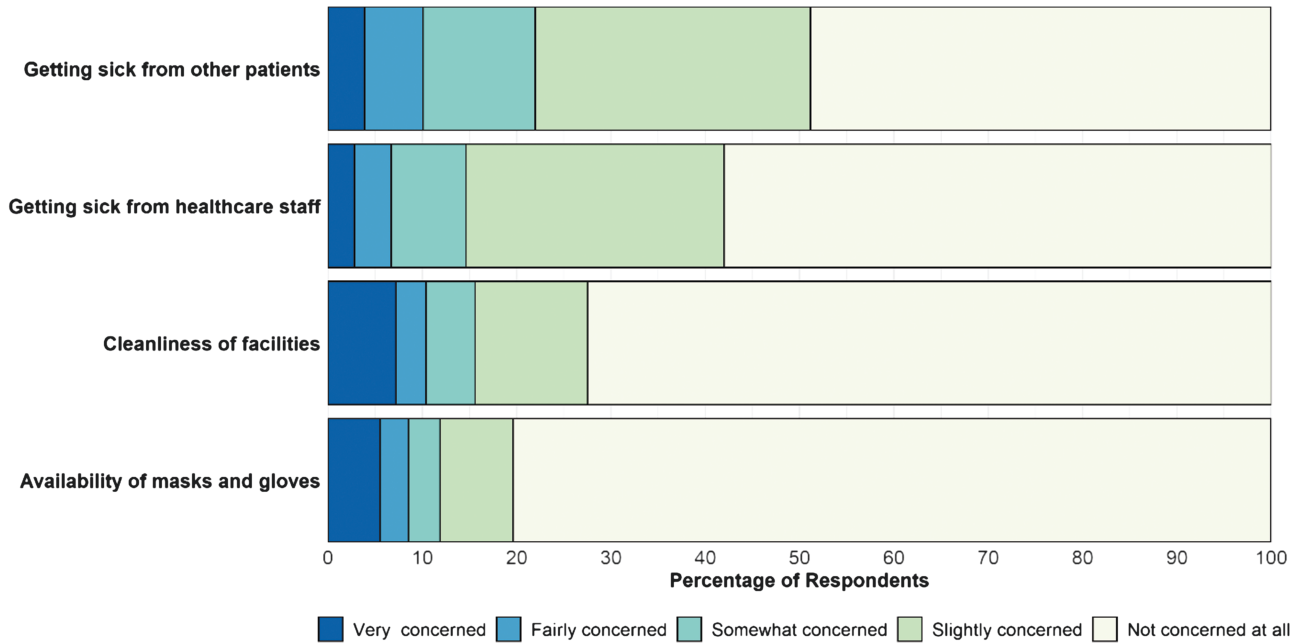
Figure 1. Respondents' ratings of concern about presenting to a breast imaging center for screening mammography during the COVID-19 pandemic. Abbreviation: COVID-19, coronavirus disease 2019.
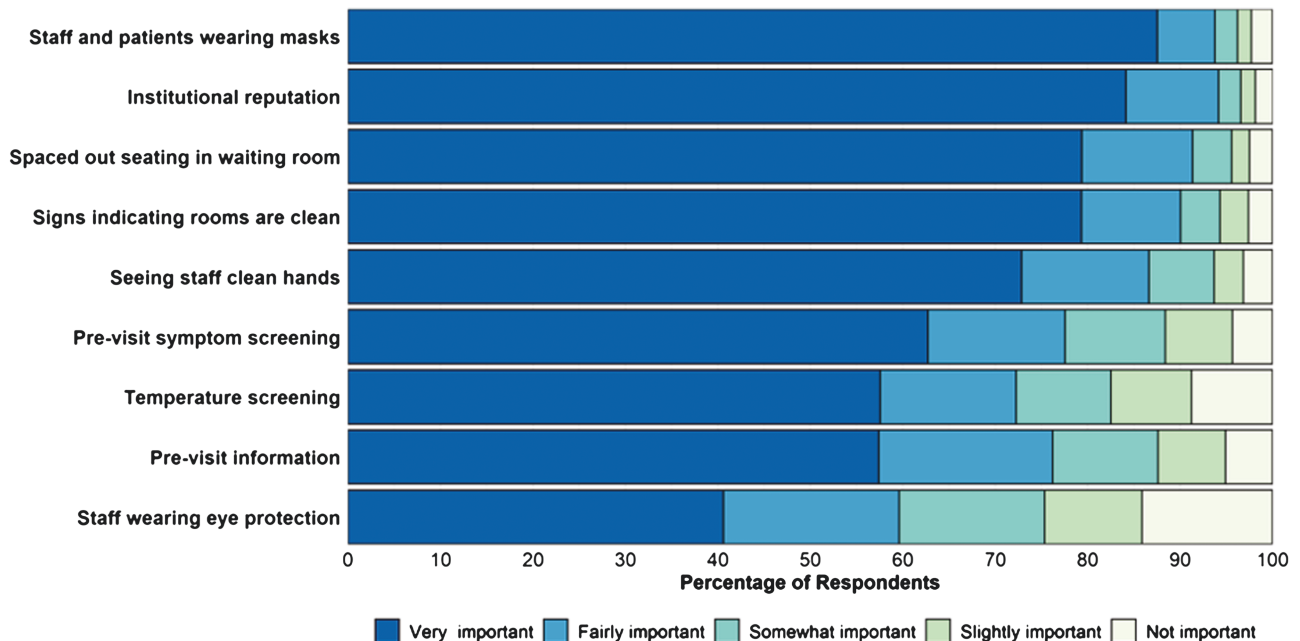

Figure 2. Respondents' ratings of importance of implemented COVID-19 precautions in breast imaging centers. Abbreviation: COVID-19, coronavirus disease 2019.

precautions in place (620/1080, 57%), and staff wearing eye protection (436/1074, 41%).

Discussion

Our multisite study found that women presenting for screening mammography during the COVID-19 pandemic were frequently anxious, with higher levels of anxiety observed in patients with multiple self-reported risk factors for either severe COVID-19 illness or breast cancer. Prior studies have found that women with breast cancer risk factors, such as family history, returned to screening mammography at the same rate as those who did not have a significant family history [17]. Since most patients diagnosed with breast cancer have no known risk factors, it is important to continue education and outreach efforts regarding the importance of annual screening among all women [18]. Furthermore, to prevent delays in care related to screening interruption during the pandemic, it will be important to institute patient-oriented policies and practices that both reduce anxiety and ensure the safety of patients and healthcare workers. Identifying which of these practices are most important to patients can help shape future interventions in the case of resurgence of the current pandemic or future pandemics.

The CDC, American College of Radiology, and Society of Breast Imaging have all issued recommendations focused on safe return to care, including screening all patients prior to appointments, redesign of waiting rooms to maintain physical distancing, and ensuring staff follow CDC guidance for personal protective equipment [7,19,20]. Given that 16% fewer women reported some level of anxiety post-visit compared to pre-visit across the six participating institutions, it is possible that the safety measures implemented at our six institutions contributed to women's decreased anxiety. Women undergoing screening mammography felt the most important patient-oriented pandemic policies and precautions included provider masking, physical distancing, signs indicating rooms are clean, and seeing staff clean their hands. These policies are easy to implement in breast imaging centers, without much additional burden on technologists and support staff.

Most respondents ranked institutional reputation as very important for their return to care. Women want to trust that their healthcare institution will ensure their safety when seeking care. While institutional reputation is difficult to actively change, institutions can emphasize their commitment to safety when contacting patients to schedule their screening mammogram, especially important during a pandemic.

While our survey indicated that women's race or ethnicity was not associated with pre-visit anxiety level, a recent report of screening mammography utilization indicated that return to screening for Hispanic and Asian women lagged compared with White and Black women [17]. Black, Asian, and Hispanic women represent 12%, 5%, and 14% of women in the United States aged 18 years or older, respectively [21]. Our U.S. study sample reflects lower proportions of Hispanic women and higher proportions of

Asian women compared to the overall population of U.S. adult women, and our study design did not include targeted oversampling of non-White respondents. However, the proportion of Black (12%), Asian (8%), and Hispanic women (3%) in our study reflects women receiving screening mammography in the United States overall. In an analysis of 1 682 504 mammograms used to calculate screening performance benchmarks, 9%, 11%, and 4% of mammograms were contributed by Black, Asian/Pacific Islander, and Hispanic women, respectively [22]. The U.S. sites in our study also represent a geographically diverse patient population. Our study included the social construct of self-identified race and ethnicity group as a predictor. While the evaluation of additional social determinants of health influencing breast cancer screening patterns was beyond the scope of this analysis, we recognize their importance and influence on healthcare delivery and outcomes [23]. Further research regarding barriers and facilitators of return to breast cancer screening for all women are needed to mitigate adverse consequences associated with delays in screening care.

Most women rated the personalized pre-visit informational phone call discussing precautions as "very important." This finding is consistent with Shifferdecker et al, who found that women valued communications that felt more personal [24]. Therefore, despite the extra time and effort it takes for staff to individually call each patient, these data suggest that this investment may improve women's sense of safety during their screening mammogram experience.

The main limitation to the study is selection bias. The women who were most concerned about having a screening mammogram during the COVID-19 pandemic may not have presented for an appointment and thus may not be represented in this survey. Of women who obtained screening mammography, those who responded to the survey were likely less anxious than women who wished to minimize exposure risk. It is possible that women who deliberately limited their interactions with the staff and moved expeditiously through the department may have been reluctant to participate in the survey. Therefore, our study did not calculate the response rate and is unable to draw comparisons to patients who did not present for a screening mammogram or who chose to not fill out the survey. The mode of survey distribution may have also resulted in an additional selection bias. The institutional review boards at two institutions required electronic surveys (via QR code) as the sole mode of survey administration. The use of QR codes to access the survey may have differentially selected for women with understanding of scanning QR codes and general digital proficiency. Furthermore, the survey was only obtained after their mammogram and not truly pre- and post-mammogram. Some patients may report feeling less anxious simply by being done with their mammogram. Additionally, the survey results were not verified given the anonymous nature of survey.

As this study was conducted between October 2020 and March 2021, it only captures the later reopening phase of

the pandemic, and responses likely reflect the local context of COVID-19 incidence at that time. Additionally, vaccinations became available to healthcare providers in December 2020 and were more widely available to patients by April 2021. Therefore, women's perceptions regarding safety may be skewed depending on the burden of disease within a specific geographic location at the time of the patient's visit. It should also be noted that we did not collect data on the women's vaccination status or personal history of COVID-19 infection and whether that affected women's anxiety in seeking healthcare.

Conclusion

Our study shows that women presenting for their screening mammogram during the ongoing COVID-19 pandemic were frequently anxious, pre-visit anxiety was associated with COVID-19 or breast cancer risk factors, and anxiety declined significantly after receipt of screening mammography. Provider masking and physical distancing were rated by the survey respondents as the most important precautions implemented by breast imaging clinics.

Supplementary Material

Supplementary material is available at the *Journal of Breast Imaging* online.

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Conflict of Interest Statement

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