Breast Cancer Screening During the COVID-19 Pandemic in the United States: Results From Real-World Health Records Data

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ABSTRACT

PURPOSE The COVID-19 pandemic abruptly interrupted breast cancer screening, an essential preventive service in primary care. We aimed to evaluate the pandemic's impact on overall and follow-up breast cancer screening using real-world health records data.

METHODS We retrospectively analyzed a cohort of women eligible for breast cancer screening through the study period from January 1, 2017 to February 28, 2022 using TriNetX Research Network data. We examined the temporal trend of monthly screening volume throughout the study period and compared the rate of adherence to follow-up screening within 24 months after the previous screening when the follow-up screening was due in the pre-COVID period vs the COVID period. To account for multiple screenings in the longitudinal data, we applied a logistic regression model using generalized estimating equations with adjustment for individual-level covariates.

RESULTS Among 1,186,669 screening-eligible women, the monthly screening volume temporarily decreased by 80.6% from February to April 2020 and then rebounded to close to pre-COVID levels by June 2020. Yet, the follow-up screening rate decreased from 78.9% (95% CI, 78.8%-79.0%) in the pre-COVID period to 77.7% (95% CI, 77.6%-77.8%) in the COVID period. Multivariate regression analysis also showed a lower adherence to follow-up screening during the COVID period (odds ratio = 0.86; 0.86-0.87) and a greater pandemic impact among women aged 65 years and older and women of non-Hispanic "other" race (Asian, American Indian or Alaska Native, and Native Hawaiian or Other Pacific Islander).

CONCLUSIONS The COVID-19 pandemic had a transient negative effect on breast cancer screening overall and a prolonged negative effect on follow-up screening. It also exacerbated gaps in adherence to follow-up screening, especially among certain vulnerable groups, requiring innovative strategies to address potential health disparities in primary care.

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INTRODUCTION

Breast cancer is the second most common cancer among women in the United States.[1] Every 1 in 8 women nationally will develop this malignancy in their lifetime,[1] and each year, 30% of newly diagnosed cancer cases in women are breast cancer.[2] The burden of breast cancer includes not only the physical and emotional toll, but also the economic impact on individuals with the disease, their families,[3] the health care system, and society as a whole.[4] Early detection of breast cancer through screening can greatly improve the chances of successful treatment and thus patients' quality of life,[5] whereas delayed or missed breast cancer screenings can lead to potentially serious health consequences, exacerbating cancer disparities among women already experiencing health inequities.

The COVID-19 pandemic led to a decline in the number of people seeking health care services, including breast cancer screening, as many screening programs were temporarily suspended because of concerns about exposure to the virus and the burden on the health care system.[6,7] Data from 6 breast imaging registries in the United States showed that breast cancer screening volumes in April 2020 were reduced to 1.1% of the April 2019 prepandemic volume, but by July 2020, had rebounded to 89.7% of the July 2019 prepandemic volume.[8] Another study based on a national screening program targeted to women with low income and inadequate insurance showed a similar rebound in screening rates, by June 2020.[9]

Self-reported data from the Behavioral Risk Factor Surveillance System (BRFSS) survey also showed an 11% decrease in past-year breast cancer screening between 2018 and 2020.[10] Other studies have likewise reported declines in breast cancer screening rates in countries around the world.[6]

Although most studies assessing the impact of the COVID-19 pandemic on cancer screening practices have been based on self-reported outcomes from health surveys,[10] or have focused on the initial phase of the pandemic using registry data or single-center health records,[6,8,11] research using real-world electronic health records (EHRs) from multiple health care systems for a longer time period since the pandemic began is limited. To fill this gap, we used a large real-world EHR network across the United States to examine changes in breast cancer screening since onset of the COVID-19 pandemic and the impact of the pandemic on follow-up screening rates.

METHODS

Data Source and Study Cohort

We used deidentified EHR data from the TriNetX Research Network database[12] (TriNetX LLC) (see Supplemental Appendix for further details). This study was exempted from institutional review board approval as only deidentified data were used. The study population included women who received at least 1 breast cancer screening and remained screening eligible with the following criteria during the study period of January 1, 2017 through February 28, 2022: (1) had no history of breast cancer (ie, no breast cancer diagnosis or bilateral mastectomy in the EHR), (2) were aged 40 to 75 years, and (3) had at least 2 years of medical history data available before January 1, 2017 and valid health records after February 28, 2022. Patients with bilateral mastectomy were excluded from breast cancer screening based on recommendations in the US Preventive Services Task Force (USPSTF) guidelines.[13] All patients' diagnoses and procedures were available between January 1, 2015 and March 1, 2023.

Breast Cancer Screening Encounters

The primary events of interest were breast cancer screening encounters throughout the study period. We aggregated the screenings from the same month as 1 screening encounter, considering that multiple screening encounters observed within a short time were likely due to duplicated records. To examine how the COVID-19 pandemic affected individual adherence to follow-up screening, we assessed the follow-up screening rate, defined as the percentage of women receiving a follow-up breast cancer screening within 24 months of their previous screening (index screening) according to clinical guidelines.[13,14] We assessed follow-up screening rates for 2 periods by whether the expected screening was due before or after March 2020, when major COVID-19 public health measures became effective in the United States:[15] (1) the pre-COVID period, when a patient received the index screening between January and December 2017 and the expected follow-up screening was due in 12 to 24 months, between January 2018 and December 2019, and (2) the COVID period, when a patient received the index screening between March 2019 and February 2020 and the expected follow-up screening was due between March 2020 and February 2022.

Covariates

Patients' baseline characteristics included sex, age, race and ethnicity, census region, and marital status. We also included common comorbidities of women with breast cancer,[16] which could potentially affect patients' health care use in general. The presence of comorbidity was determined if the patient had at least 2 encounters with the corresponding diagnosis code(s) in separate months within the past 2 years. Patients' prior preventive care visits, mental health visits, and visits with cervical cancer screening (a surrogate representing the awareness of common preventive cancer care in women) in the past 2 years were also included to capture their access to other general health services. Multiple visits within the same month were treated as 1 to reduce variability in the derived measures. All of the age, comorbidity, and health service visit measures were determined at baseline (January 2017) and at each index screening. Detailed medical codes for diagnoses and procedures can be found in Supplemental Table 1 and Supplemental Table 2.

Statistical Analysis

We first examined the overall temporal changes in breast cancer screening volume and compared the crude rates of follow-up screening before and after the pandemic began. Specifically, we computed the monthly volume of breast cancer screenings in the study cohort from January 2017 to February 2022, which was then stratified by demographic subgroup. We then calculated the crude rate of follow-up screening in the pre-COVID period and the COVID period, respectively, and evaluated the differences using the 2-sample z test of proportions for the overall cohort and each demographic subgroup separately.

In addition, we conducted a multivariate logistic regression analysis to more comprehensively examine how the COVID-19 pandemic affected follow-up screening using individual-level data. The binary outcome was whether a patient received a follow-up screening within 24 months after a previous screening (the index screening). The primary binary independent variable was whether the follow-up screening was due during the COVID period (vs the pre-COVID period as the reference). We adjusted for covariates of sex, race and ethnicity, marital status, census region at baseline, and age, comorbidities, and prior health service use at the index screening. To account for repeated measures (ie, observations in both periods), we applied generalized estimating equations (GEEs) with an exchangeable working correlation structure as our base case model.[17] In addition to reporting the odds ratio (OR), we also report the average marginal effect (AME) for

easier interpretation of effect sizes from the logistic regression analyses.[18] Sensitivity analyses tested different groupings of comorbidities (Supplemental Table 3), independence of the working correlation structure for the GEE model, and restricting analyses to samples having observations in both periods (ie, balanced panel data). We report 95% CIs for all estimates, and all tests were 2-sided, with *P* values less than .05 considered to be statistically significant. Data analysis and statistical modeling were performed in Python 3.9.5 (Python Software Foundation).

RESULTS

Cohort Characteristics

We identified 1,186,669 women from the TriNetX Research Network who met our inclusion criteria during the study period (Table 1 and Supplemental Figure 1). The study cohort had an average age of 54.8 years and were predominately non-Hispanic White (50.3%) and less often non-Hispanic Black (12.9%) or Hispanic (7.2%); the largest share were from the Northeast Region (41.3%) followed by the South Region (30.9%). Common comorbidities for breast cancer that were present in at least 5% of the study cohort included hypertension (17.9%), hyperlipidemia (14.3%), diabetes (7.6%), depression (6.9%), and hypothyroidism (6.6%).

Monthly Volume of Breast Cancer Screening

We observed that the monthly volume of breast cancer screening in the study cohort increased slowly up to February 2020 before the COVID pandemic (Figure 1). Compared with the volume in February 2020, the volume decreased sharply in March (a 35.6% reduction), reaching a nadir by April (an 80.6% reduction); it then rebounded to the prepandemic level by June 2020, with fluctuations thereafter. Temporal trends in screening volume for demographic subgroups demonstrated similar patterns, with the same immediate impact of the COVID-19 pandemic (Supplemental Figure 2).

Adherence to Follow-up Screening

In the pre-COVID period, we estimated that 78.9% (95% CI, 78.8%-79.0%) of women adhered to a follow-up screening within 24 months after their previous (index) screening (Table 2). This percentage decreased to 77.7% (95% CI, 77.6%-77.8%) when the follow-up screening was due during the COVID period. The decrease in the follow-up screening rate was small but significant (−1.2%; 95% CI, −1.3% to −1.0%).

Our stratified analysis showed a disparate impact of COVID across demographic subgroups, with a larger decrease in the follow-up rate observed among older age groups (−1.9%; 95% CI, −2.1% to −1.6% for those aged 50-64 years; −3.2%; 95% CI, −3.6% to −2.9% for those aged ≥65 years), and among non-Hispanic women of "other" race, which included women who were Asian, American Indian or Alaska Native, and Native Hawaiian or Other Pacific Islander (−4.5%; 95% CI, −5.7% to −3.4%).

Table 1. Baseline Characteristics of the Study Cohort

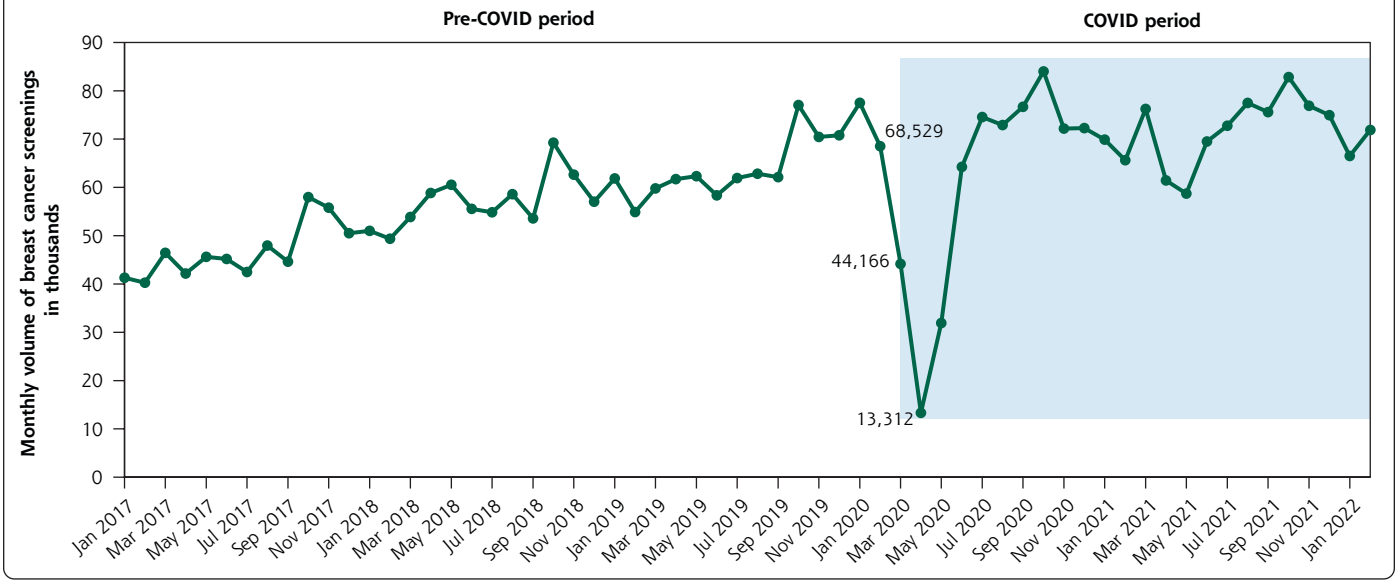
Characteristic	Patients, No. (%) (N = 1,186,669)
Age group[a]	
40-49 years	358,926 (30.2)
50-64 years	651,740 (54.9)
≥65 years	176,003 (14.8)
Race and ethnicity	
Non-Hispanic White	596,584 (50.3)
Non-Hispanic Black	152,816 (12.9)
Non-Hispanic other	21,732 (1.8)
Hispanic	85,060 (7.2)
Unknown	330,477 (27.8)
Marital status	
Married	263,703 (22.2)
Single	201,456 (17.0)
Unknown	721,510 (60.8)
Regional location	
Northeast	489,763 (41.3)
South	367,073 (30.9)
Midwest	216,939 (18.3)
West	112,894 (9.5)
Comorbidities	
Ischemic heart disease	18,260 (1.5)
Heart failure	8,216 (0.7)
Depression	82,227 (6.9)
Cerebrovascular disease	12,937 (1.1)
Diabetes	90,225 (7.6)
Osteoporosis	29,428 (2.5)
Hypothyroidism	78,094 (6.6)
Hypertension	212,097 (17.9)
Hyperlipidemia	170,074 (14.3)
Renal failure	29,721 (2.5)
COPD	23,700 (2.0)
Atrial fibrillation/atrial flutter	12,164 (1.0)
Health care service visits	
Mental health visits	
0	970,611 (81.8)
1-2	126,838 (10.7)
≥3	89,220 (7.5)
Preventive care visits	
0	935,806 (78.9)
1	149,265 (12.6)
≥2	101,598 (8.6)
Cervical cancer screening visits	
0	1,075,761 (90.7)
≥1	110,908 (9.3)

COPD = chronic obstructive pulmonary disease.

[a] Mean (SD) age was 54.8 (8.2) years.

Accounting for multiple screenings in longitudinal data and adjusting for individual-level demographic and clinical factors, the logistic regression analysis showed that women

Figure 1. The monthly volume of breast cancer screenings in the study cohort (N = 1,186,669) before and after onset of the COVID-19 pandemic, January 2017 through February 2022.



were significantly less likely to adhere to a follow-up screening within 24 months during the COVID period compared with the pre-COVID period (Table 3). The adjusted OR was 0.86 (95% CI, 0.86-0.87), equivalent to an AME of –2.5% (95% CI, –2.3% to –2.6%), meaning that there was a 2.5% reduction in the likelihood of adhering to follow-up screening while the pandemic was ongoing. Women of younger ages and in racial and ethnic minority groups were less likely to have follow-up screening in general. Sensitivity analyses further validated the robustness of results under different model configurations (Supplemental Table 4 and Supplemental Table 5). Moreover, additional interaction effects (Supplemental Table 6) and stratified analyses (Supplemental Table 7) showed a consistent impact of COVID across subgroups, with relatively higher impact of the pandemic on women who were older (adjusted OR = 0.86 [95% CI, 0.85-0.87] for the age group 50-64 years and 0.78 [95% CI, 0.76-0.80] for the age group ≥65 years compared with 0.95 [95% CI, 0.93-0.97] for the age group 40-49 years) and on women of non-Hispanic other race (adjusted OR = 0.71; 95% CI, 0.67-0.76).

Table 2. Comparison of the Breast Cancer Screening Follow-up Rate Between the Pre-COVID Period and the COVID Period

	Follow-up Screening Rate,[a] % (95% CI)		
Group	**Pre-COVID Period[b]**	**COVID Period[c]**	**Difference, % (95% CI)**
Total	78.9 (78.8 to 79.0)	77.7 (77.6 to 77.8)	−1.2[d] (−1.3 to −1.0)
Age group			
40-49 years	73.9 (73.7 to 74.2)	74.0 (73.7 to 74.2)	0.1 (−0.3 to 0.4)
50-64 years	79.7 (79.5 to 79.9)	77.9 (77.6 to 78.0)	−1.9[d] (−2.1 to −1.6)
≥65 years	83.6 (83.3 to 83.8)	80.3 (80.1 to 80.5)	−3.2[d] (−3.6 to −2.9)
Race and ethnicity			
Non-Hispanic White	81.2 (81.0 to 81.3)	80.3 (80.2 to 80.5)	−0.8[d] (−1.0 to −0.6)
Non-Hispanic Black	76.8 (76.4 to 77.1)	76.3 (76.0 to 76.6)	−0.4 (−0.9 to 0.0)
Non-Hispanic other[e]	79.2 (78.3 to 80.1)	74.8 (74.0 to 75.6)	−4.5[d] (−5.7 to −3.2)
Hispanic	70.8 (70.3 to 71.3)	70.3 (69.8 to 70.7)	−0.5 (−1.2 to 0.2)
Unknown	77.4 (77.2 to 77.7)	74.9 (74.7 to 75.1)	−2.5[d] (−2.8 to −2.2)
Marital status			
Married	78.8 (78.5 to 79.0)	76.5 (76.3 to 76.7)	−2.3[d] (−2.6 to −2.0)
Single	76.2 (75.9 to 76.5)	75.1 (74.8 to 75.3)	−1.1[d] (−1.5 to −0.7)
Unknown	79.8 (79.6 to 79.9)	78.8 (78.7 to 79.0)	−0.9[d] (−1.1 to −0.7)
Regional location			
Northeast	80.9 (80.7 to 81.1)	79.3 (79.2 to 79.5)	−1.6[d] (−1.8 to −1.4)
South	77.3 (77.0 to 77.5)	76.0 (75.8 to 76.2)	−1.3[d] (−1.6 to 1.0)
Midwest	80.5 (80.3 to 80.7)	80.5 (80.3 to 80.7)	0.0 (−0.3 to 0.3)
West	70.6 (70.2 to 71.1)	67.8 (67.4 to 68.2)	−2.9[d] (−3.5 to −2.2)

[a] Follow-up screening rate is defined as the percentage of women who received a follow-up breast cancer screening within 24 months of their previous (index) screening.
[b] If a woman was screened during 2017, her follow-up screening was due before 2020, which was considered to be the pre-COVID period.
[c] If a woman was screened between March 1, 2019 and February 28, 2020, her follow-up screening was due between March 1, 2020 and February 28, 2022, which was considered to be the COVID period.
[d] $P < .01$.
[e] Asian, American Indian or Alaska Native, and Native Hawaiian or Other Pacific Islander.

Table 3. Adjusted Odds Ratios and Average Marginal Effects for Follow-up Breast Cancer Screening

Measure	Adjusted Odds Ratio (95% CI)	Average Marginal Effect, % (95% CI)
Period		
Pre-COVID (ref)	…	…
COVID	0.86 (0.86 to 0.87)	−2.5 (−2.6 to −2.3)
Age group		
40-49 years (ref)	…	…
50-64 years	1.28 (1.26 to 1.29)	4.1 (3.9 to 4.3)
≥65 years	1.54 (1.52 to 1.56)	7.3 (7.0 to 7.6)
Race and ethnicity		
Non-Hispanic White (ref)	…	…
Non-Hispanic Black	0.84 (0.82 to 0.85)	−3.0 (−3.3 to −2.7)
Non-Hispanic other[a]	0.82 (0.79 to 0.85)	−3.4 (−4.0 to −2.8)
Hispanic	0.69 (0.68 to 0.71)	−6.2 (−6.6 to −5.9)
Unknown	0.68 (0.67 to 0.69)	−6.5 (−6.7 to −6.3)
Marital status		
Married (ref)	…	…
Single	0.97 (0.95 to 0.98)	−0.6 (−0.8 to −0.3)
Unknown	1.07 (1.06 to 1.09)	1.2 (1.0 to 1.4)
Regional location		
Northeast (ref)	…	…
South	0.77 (0.76 to 0.79)	−4.3 (−4.6 to −4.1)
Midwest	0.82 (0.80 to 0.83)	−3.4 (−3.7 to −3.1)
West	0.50 (0.49 to 0.51)	−11.7 (−12.0 to −11.3)
Comorbidities[b]		
Ischemic heart disease	0.88 (0.85 to 0.90)	−2.2 (−2.7 to −1.8)
Heart failure	0.86 (0.82 to 0.90)	−2.6 (−3.3 to −1.9)
Depression	0.94 (0.92 to 0.96)	−1.1 (−1.4 to −0.8)
Cerebrovascular disease	0.92 (0.89 to 0.95)	−1.4 (−1.9 to −0.8)
Diabetes	0.93 (0.91 to 0.94)	−1.2 (−1.5 to 1.0)
Osteoporosis	1.36 (1.32 to 1.40)	5.2 (4.7 to 5.7)
Hypothyroidism	1.05 (1.04 to 1.07)	0.9 (0.6 to 1.2)
Hypertension	1.05 (1.04 to 1.07)	0.9 (0.6 to 1.1)
Hyperlipidemia	1.30 (1.28 to 1.32)	4.5 (4.2 to 4.7)
Renal failure	0.82 (0.80 to 0.84)	−3.3 (−3.8 to −2.9)
COPD	0.79 (0.77 to 0.81)	−4.0 (−4.5 to −3.5)
Atrial fibrillation/atrial flutter	0.99 (0.95 to 1.03)	−0.1 (−0.8 to 0.5)
Health care service visits		
Mental health visits (ref = 0)		
1-2	0.85 (0.84 to 0.86)	−2.8 (−3.0 to −2.6)
≥3	0.90 (0.88 to 0.92)	−1.8 (−2.1 to −1.4)
Preventive care visits (ref = 0)		
1	1.20 (1.18 to 1.21)	3.1 (2.9 to 3.2)
≥2	1.84 (1.81 to 1.87)	10.3 (10.0 to 10.6)
Cervical cancer screening visits (ref = 0)		
≥1	1.26 (1.24 to 1.28)	3.9 (3.6 to 4.1)

COPD = chronic obstructive pulmonary disease; ref = reference group.

[a] Asian, American Indian or Alaska Native, and Native Hawaiian or Other Pacific Islander.

[b] Reference group for each is those without the comorbidity.

Note: From the logistic regression model, using the generalized estimating equations method with an exchangeable working correlation structure (N = 761,508 individuals, N = 1,076,676 observations).

DISCUSSION

In this study, we used an innovative approach to evaluate the impact of the COVID-19 pandemic on breast cancer screening in the United States, analyzing real-world longitudinal EHR data from a large national health research network. We found that the monthly volume of breast cancer screening among eligible women decreased sharply at the start of the pandemic, but quickly returned to close to prepandemic levels after June 2020. As new virus strains emerged after the initial wave, the volume decreased and rebounded over time as people might hesitate to visit their health care professionals because of fear of contracting COVID-19.[19] We also found that women were less likely to adhere to follow-up screening within the recommended time window during the pandemic period than during the prepandemic period.

Our results showed a consistent picture of a pandemic-induced gap in breast cancer screening[20] as has been observed in other studies.[21] Using various data sources, such as survey data,[10,22] mammography registry databases,[23] and medical records,[24-27] those studies examined the pandemic's impact by focusing on the relative reduction in screening volumes or the past-year screening rate compared with that in the pre-COVID period. Essentially, we have confirmed the temporal trends by measuring the pandemic's impact on follow-up screening behaviors. Leveraging individual-level longitudinal data enabled us to identify patients who already had some experience with breast cancer screening, and then tracked them over time to examine whether they had timely follow-up screenings. This approach allowed us to assess the COVID-19 impact on follow-up screening specifically in women who already had a history of breast cancer screening, which could differ from the impact on missed breast cancer screening among women who had never been screened before. The overall 2.5% reduction (AME) in the follow-up screening rate caused by the pandemic may seem small, but it implies a large number of missed opportunities for follow-up screenings considering the scale of the population.

Besides showing the continuing disparities in the gap of breast cancer screening, our study identified how such a gap has been exacerbated differently across demographic subgroups. For instance, although older women were more likely to be screened,[28] we found larger decreases in follow-up screening rates in this population during the pandemic, consistent with the literature showing a large decline in cancer screening rates for most older adults during the pandemic.[25,29] Decisions for postponing cancer screening could be due to numerous uncertainties of older adults regarding their health conditions and fear of COVID-19 infection, especially among older women. Such delays could result in late-stage diagnoses and worse health outcomes for patients at high risk of morbidity and mortality. Consistent with prior research,[30-32] our analysis also showed that individuals in racial and ethnic minority groups had lower screening rates than their White counterparts; moreover, the pandemic maintained or exacerbated these existing disparities. These disparities could be partly attributed to socioeconomic factors. Compared with White women, women of other races were more likely to be unemployed and uninsured because of the economic downturn caused by the pandemic,[33-35] preventing them from accessing essential preventive care services and follow-up. Future research is needed to further understand the underlying social determinants that drive the current gap and disparities, and how the disruption in health services could exacerbate the gaps through these factors.

To close breast cancer screening gaps and persistent disparities in this screening among minority women and women experiencing socioeconomically challenges and chronic illness, research has shown success by leveraging peer support,[36] community outreach,[37,38] and patient navigators to help access cancer screening information and services,[39-41] especially in high-risk populations.[42] As clinical decision support systems and machine learning techniques continue to advance, future navigation processes can use risk models to aid patient navigators in personalizing strategies that target key barriers to help patients overcome personal, health systems, and geosocial-related obstacles to screening.[42]

Our study has some limitations. First, considering the practical limit on cohort size at our data request, we did not include women who were eligible for but never received breast cancer screening and selected a fixed cohort who remained screening eligible throughout the study period. As a result, our estimated follow-up screening rates were higher than those commonly reported for the general population.[1] On the other hand, we did not expect this data limitation to substantially impact our main findings, as our analysis focused on temporal comparisons to assess the impact of the pandemic rather than reporting population health statistics in general. Second, as in other studies using EHR data, clinical variables extracted based on diagnosis and procedure codes may be subject to variations in medical coding by clinicians and possible missingness if a patient receives services from multiple clinicians. This concern is partially resolved in the TriNetX data, as it has already linked individuals when harmonizing data from multiple sources. Moreover, our inclusion criteria also required the timespan of an individual's health records to be long enough to provide as complete information as possible. Lastly, we had limited data on patients' social determinants of health or geolocation for linking to such data, despite their critical roles in influencing service use and health outcomes. Future research is needed to incorporate the social determinants of health to better understand the existing disparities and the barriers to achieving higher screening adherence.

CONCLUSIONS

The COVID-19 pandemic abruptly interrupted breast cancer screening services, an essential preventive service in primary care. This study revealed that despite a quick return to the baseline screening volume after only a few months since pandemic onset, there was a small but significant decrease in the follow-up screening rate during the pandemic vs before the pandemic. In addition to showing persistent disparities in breast cancer screening and larger gaps in younger women and all racial and ethnic minority groups as before the pandemic, we also showed a disparate impact of the pandemic whereby gaps in screening adherence were further exacerbated, especially in older women and in racial and ethnic minority groups. As the full impact of the pandemic continues to play out, future studies are needed to assess its long-lasting impact on breast cancer screening and other preventive care services. As health systems around the world start to recover from the disruptions in essential health services after 3 years of the pandemic, innovative care navigation strategies, such as focused outreach efforts, are needed to close the gap and improve the stagnant breast cancer screening rate, adherence rate, and outcomes. Understanding the medical comorbidities and social determinants that impact screening adherence in the COVID period and how they drive current gaps and disparities is crucial for family physicians and health systems to provide the best care for their patients.

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Key words: breast cancer; cancer screening; women's health services; health care disparities; patient compliance; COVID-19; electronic health records; preventive medicine; social determinants of health; health disparate minority and vulnerable populations; primary care

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Supplemental materials

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