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# The Impact of the COVID-19 Pandemic on Attendance and Diagnostic Outcomes at Breast Screen Western Sydney, Australia

Katelin Yarde[£a], Tessa Hunt[£a], Kerry Hitos[b,c], Aswin Shanmugalingam[d], Nicholas Ngui[e], Nirmala Pathmanathan[c,f], Meagan E Brennan[*a,c,f]

[a]*National School of Medicine, The University of Notre Dame, Darlinghurst, NSW, Australia*

[b]*Westmead Research Centre for Evaluation of Surgical Outcomes, Department of Surgery, Westmead Hospital, Westmead, NSW, Australia*

[c]*Westmead Clinical School, Faculty of Medicine and Health Sciences, The University of Sydney, NSW, Australia*

[d]*Department of Surgery, Westmead Hospital, Westmead, NSW, Australia*

[e]*Department of Surgery, Blacktown/ Mt Druitt Hospitals, NSW, Australia*

[f]*Westmead Breast Cancer Institute, Westmead Hospital, Westmead, NSW, Australia*

[£]Joint first authors. Katelin Yarde and Tessa Hunt contributed equally to this work and share first authorship.

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ABSTRACT

**Background:** BreastScreen, Australia's population screening program, was disrupted by the COVID-19 pandemic. This study examined the pandemic's effect on attendance and assessment outcome data to inform service planning for the recovery period.

**Methods:** BreastScreen Western Sydney data from 'pre-COVID' (2018 and 2019) versus 'COVID-affected' years (2020 and 2021) were analyzed. The number of screens, recall rate, sociodemographic data of clients, and imaging and pathological features of malignancies were also analyzed.

**Results:** During the four-year study period, COVID-affected years demonstrated an 18.8% reduction in screening episodes (77 510 vs 95 467, $P < 0.001$) and a 16.3% reduction in malignancies (512 vs 612, $P = 0.49$) compared to pre-COVID years. The cancer detection rate (cancers detected per 10 000 screens) remained similar (52.8 vs 52.3 per 10 000 screens for invasive cancer, $P = 0.89$ and 66.1 vs 64.1 for all malignancies, $P = 0.62$), and the recall rate was lower (4.2% vs 4.8%, $P < 0.001$). Younger women and first-time screeners were less likely to attend during COVID-19. There was no significant difference in the proportion of ductal carcinoma in situ (DCIS) vs invasive cancers (20.1% vs 18.5%, $P = 0.48$), the mean invasive tumor size (18.7 mm vs 17.8 mm, $P = 0.37$), or the size of DCIS (46.4 mm vs 21.8 mm, $P = 0.11$) between COVID-affected and pre-COVID years.

**Conclusion:** There was an expected reduction in the number of screens and cancers detected during COVID-19, without a change in tumor size or cancer detection rate. Younger women should be targeted for catch-up screening. Services should plan for the 19% of the screening cohort that failed to attend during the pandemic, as they may present with later-stage cancers.



***Address for correspondence:**
Prof Meagan E Brennan
Postal Address: Westmead Breast Cancer Institute, Westmead Hospital, PO Box 143, Westmead NSW 2145, Australia
Email address: meagan.brennan@sydney.edu.au

## INTRODUCTION

Breast cancer is the most common cancer and the leading cause of cancer death in Australian women.[1] Morbidity and mortality resulting from breast cancer can be reduced through early detection in population-based screening programs. BreastScreen is a joint

initiative between the Australian federal and state governments, and it provides free mammographic screening for asymptomatic women from age 40. The service targets women aged 50–74 years for biennial digital mammography, and those aged 40–49 years or ≥75 years are eligible to attend on client or medical practitioner request. If indicated by personal medical or family history, screening may be offered annually.[1] In 2017–2018, over 1.8 million women participated in BreastScreen Australia, a participation rate of 54.8% of the target population. The participation rate in Western Sydney was lower at 39.9%.[2]

When the COVID-19 pandemic emerged in early 2020, New South Wales (NSW), Australia, was subjected to varying levels of government-mandated restrictions in response to rising COVID-19 case numbers. This included temporary closure of non-urgent healthcare services, deferral of appointments, and shifts to virtual care, along with strict stay-at-home orders and travel restrictions. BreastScreen Western Sydney closed for the periods of 26 March to 4 May 2020, and 29 June to 13 October 2021.[3] Outside these lockdown-associated closure periods, screening participation was further reduced by patient reluctance to seek healthcare due to concerns of COVID-19 exposure, further burdening the healthcare system, and COVID-19-related restrictions in movement around the city, which were particularly limiting in Western Sydney[4].[4] There was limited availability of screening, as many sites (such as those in retail locations) were closed even when the service was operational. Furthermore, reduced availability of healthcare workers, frequently deployed to conduct COVID-19-related duties, created an additional challenge to the BreastScreen service.[4]

Several studies predicted that a reduction in the number of breast screening episodes may translate to a reduction in the number of early-stage cancer diagnoses.[1,5,6] Modelling for Australia predicted a short-term post-COVID-19 increase in cancer stage at diagnosis, reflected by increases in tumor size, nodal involvement, and high-grade tumors.[6] This was also predicted in England, the broader United Kingdom, and Canada, which also experienced similar closures to their breast screening services.[1,7,8] In the long-term post-pandemic period, there may be a demand for more intensive treatment for breast cancer, due to diagnostic delays, and this may be accompanied by an increase in cancer mortality. Some of these predictions have proven correct as publications emerge describing reductions in screening numbers and an increased proportion of later-stage cancers diagnosed during the pandemic.[5] As the impact of COVID-19 on health services varied significantly between jurisdictions, it is important for individual districts to evaluate the real-world effect on their local area.

The aims of this study were to (1) explore the impact of the COVID-19 pandemic on breast screening, including the magnitude of the reduction in screening episodes, and changes in client demographics and imaging features of breast cancers diagnosed in 2020–2021; and (2) use this information to make recommendations for service provision during the post-pandemic recovery. No previous research has evaluated the impact of the pandemic on screening in the Australian context.

## METHODS

This is a retrospective descriptive cross-sectional study. Ethics approval was obtained from the Western Sydney Local Health District (WSLHD) Human Research Ethics Committee (Quality Assurance project 2206-01 NGUI) and The University of Notre Dame Australia Human Research Ethics Committee (Cross-Institutional approval 2022-095S). Approval was given by the Cancer Institute NSW, the BreastScreen data custodian, prior to the release of the data.

### *Study setting*

BreastScreen Western Sydney covers the health districts of Western Sydney (local government areas Parramatta, Cumberland, Blacktown, and The Hills Shire, total population 1 053 142) and Nepean Blue Mountains (local government areas Penrith, Hawkesbury, Lithgow, Blue Mountains, and Mid-Western Regional, total population 385 739). It performed approximately 47 700 screens per year in 2019 and earlier, before services were affected by the COVID-19 pandemic.

### *Data collection*

De-identified data were provided by BreastScreen NSW. Data on screening episodes for women who were residents and screened in the BreastScreen Western Sydney area between January 2018 and December 2021 were included. Women with a residential address in Western Sydney who attended a center in Western Sydney for screening were eligible for inclusion.

Data contained fields describing demographics, including age, country of birth, and postcode of residence. Country of birth data were collapsed and coded by continent, according to the United Nations Geographic Regions.[9] Socioeconomic deciles were assigned based on residential address using Australian Bureau of Statistics Socio-Economic Indexes for Areas (SEIFAs).[10]Screening episode and outcome data included screening round, interval from last screen, visit frequency recommended by

BreastScreen (annual or biennial), presence/absence of symptoms (reported by the client), recall to assessment (recall for work-up of an abnormality reported on screening mammogram), assessment results (results from work-up with further mammography, ultrasound and/or biopsy), and final recommendation (treatment of cancer or return to screening). For cases of breast cancer, data on lesion type (invasive or non-invasive) were determined from excision histology or core biopsy. Imaging size and palpability were determined from clinical and imaging assessment following recall.

*Data analysis and statistical methods*

Descriptive statistical analysis was performed using SPSS version 22.0.[11] Data distribution was checked for normality using the Kolmogorov-Smirnov test with Lilliefors significance. Continuous variables were presented with means and standard deviation (SD). The student's t-test for parametric data or the Mann-Whitney U test for non-parametric distribution was used. Categorical data, such as differences between groups and screening outcomes, were reported using percentages and raw numbers. Differences between groups were analyzed using the chi-square analysis or analysis of variance (ANOVA). All tests were two-tailed, and a $P \leq 0.05$ was considered statistically significant. For all variables, data were stratified into 'Pre-COVID years' (2018 and 2019) and 'COVID-affected years' (2020 and 2021), and a P value was calculated for the difference between the two groups. Further analysis calculated year-on-year P-values (comparing the individual years 2018, 2019, 2020, and 2021), independent of COVID-19 status.

## RESULTS

*Screening and cancer detection data*

Data were obtained for 172 977 screening episodes leading to 1124 cancer diagnoses across four years (Table 1). COVID-affected years demonstrated an 18.8% reduction in screening episodes (77 510 vs 95 467, $P < 0.001$) and a 16.3% reduction in total malignancies (512 vs 612, $P = 0.49$) compared to pre-COVID years. There was a non-significant 8.8% reduction in case numbers for ductal carcinoma in situ (DCIS) (113 pre-COVID vs 103 COVID-affected, $P = 0.49$) and an 18% reduction in case numbers for invasive cancers (499 pre-COVID vs 409 COVID-affected, $P = 0.49$).

The reduction in case numbers varied between the two COVID-affected years (2020 and 2021). In 2018 (pre-COVID baseline), 47 834 women were screened, and there were 304 malignant diagnoses (DCIS and invasive combined). In 2020 (the first COVID-affected year), there was a 9.4% reduction in screens (n = 43 324) and an 8.8% reduction in malignant diagnoses (n = 277).

**Table 1.** Screening Attendance, Recall Rate, and Cancer Diagnoses in BreastScreen Sydney West 2018–2021, by Year and COVID Grouping

| | | 2018 | 2019 | Pre-COVID Total | 2020 | 2021 | COVID-affected Total | Total (Pre-COVID and COVID-affected) | Year-on-year P-value* | Pre-COVID vs COVID-affected P-value** |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of screens | | 47834 | 47633 | 95467 | 43324 | 34186 | 77510 | 172977 | | |
| Recall rate n (%) of screens | | 2279 (4.8) | 2283 (4.8) | 4562 (4.8) | 1769 (4.1) | 1457 (4.3) | 3226 (4.2) | n/a | <0.001 | <0.001 |
| Malignant diagnoses n (%) | DCIS | 61 (20.1) | 52 (16.9) | 113 (18.5) | 46 (16.6) | 57 (24.3) | 103 (20.1) | 216 (19.2 | <0.001 | 0.49 |
| | Invasive cancer | 243 (79.9) | 256 (83.2) | 499 (86.1) | 231 (83.4) | 178 (75.7) | 409 (79.9) | 908 (80.8) | | |
| | Total malignancy | 304 | 308 | 612 | 277 | 235 | 512 | 1124 | | |
| Cancer detection rate (per 10,000 screens) | Invasive malignancy | 50.8 | 53.7 | 52.3 | 53.3 | 52.1 | 52.8 | n/a | 0.93 | 0.89 |
| | All malignancy | 63.6 | 64.7 | 64.1 | 63.9 | 68.7 | 66.1 | n/a | 0.81 | 0.62 |

* Comparison between 2018, 2019, 2020, and 2021

** Comparison between 'Total pre-COVID' (2018 and 2019 combined) and 'Total COVID' (2020 and 2021 combined)

In 2021, a greater decrease was observed, with a 28.5% reduction in screens (n = 34 186) and a 22.7% reduction in cancer diagnoses (n = 235) compared to 2018 ($P < 0.001$ and $P = 0.24$ for reductions in screens and cancer diagnoses, respectively).

BreastScreen recall rate (proportion of women undergoing screening mammography who were called back for assessment of a mammographic abnormality) was lower during the COVID-affected years (4.2% vs 4.8%, $P < 0.001$) compared to pre-COVID years. The cancer detection rate (DCIS and invasive tumors) remained similar (66.06 and 64.11 per 10 000 screens), with the detection rate for invasive carcinomas remaining stable (52.3 and 52.8 per 10 000 screens), in pre-COVID and COVID-affected years, respectively.

*Demographic Variables*

Demographic data for screening participants for individual years and pre-COVID and COVID-affected (2020 and 2021) years are summarized in Table 2.

Compared to pre-COVID years, the COVID-affected years showed an increase in the median age of BreastScreen participants from 60.36 years to 60.77 ($P < 0.001$). This is also reflected in reductions in the < 50 years (6.9% vs 5.9%) and 50–64 years (57.6% vs 56.8%) groups, compared to those > 64 years of age (35.5% vs 37.3%, $P < 0.001$). The COVID-affected years showed a reduction in the proportion of attendees who were born in Europe and Oceania compared to pre-COVID years. An increase in the proportion of attendees born in all other continents was also noted during COVID-affected years compared to pre-COVID ($P < 0.001$). No difference in screening attendance was noted between people from English-speaking and non-English-speaking homes ($P = 0.10$).

Overall, the COVID-affected years showed a significant difference ($P < 0.001$) in the proportion of clients attending from different SES deciles. There was a trend towards a reduction in attendance from women of lower SES deciles during COVID-affected years, although this pattern was inconsistent.

*Screening Outcomes*

Data for screening episode outcomes for participants by individual year and pre-COVID (2018 and 2019) or COVID-affected (2020 and 2021) years are summarized in Table 1, Table 2, and Supplementary Table A.

COVID-affected years showed a decrease in the proportion of clients attending for their first or second mammogram compared to pre-COVID years (16.2% vs 13.0% first round, and 14.0% vs 13.3% for second, $P < 0.001$). While the recall rate fell during the pandemic, there were no differences in the proportion of clients referred for routine screening, early review, or cancer treatment.

*Screening characteristics of malignancies*

Cancer characteristics are shown in Table 2. No difference was found between COVID-affected years compared to pre-COVID for either the mean size of invasive tumors (18.7 mm vs 17.8 mm, $P = 0.37$), or DCIS (46.4 mm vs 21.8 mm, $P = 0.11$). There was also no difference in the T-stage of tumors on imaging ($P = 0.24$). There was no significant difference in the proportion of palpable lesions in COVID-affected years compared to pre-COVID years ($P = 0.09$). There was also no difference in axillary lymph node biopsy result (malignant vs non-malignant, $P = 1.00$). Palpability was significantly lower in 2021 (21%) compared to other years (26%, 30%, and 30% for 2018, 2019, and 2020) and this was significant in year-on-year analysis ($P < 0.001$) but not on COVID-affected vs pre-COVID analysis ($P = 0.09$).

## DISCUSSION

This retrospective study reports the effect of the COVID-19 pandemic on attendance and outcomes at a large metropolitan population breast screening service. A significant reduction in the number of clients presenting for mammographic screening during the initial phase of the COVID-19 pandemic was seen. This can be partly attributed to the closure of the screening program for six weeks in 2020 and a longer period in 2021. There was also limited capacity for several months on re-opening due to staff deployment to COVID-19 duties and the requirements for additional cleaning protocols and social distancing for clients attending for screening. In Sydney, extremely restrictive lockdowns continued intermittently through 2021. A reduction in overall screening numbers is therefore expected and is consistent with the experience of other services around the world.[5] However, the magnitude of the reduction was relatively low (a 19% reduction) compared to a systematic review that found over 35 studies reporting a reduction of ≥50% related to COVID-19.[5]

One of the aims of this study was to examine whether the demographic mix of clients attending was different during the COVID-affected years. Younger women were less likely to attend, reflected by lower screening rates for women under age 50 and an increase in the median age in the COVID-affected years.

Related to this, attendance for first-time screeners was lower. The reasons for this are unclear, but it may be due to the assumption that the target age for screening is 50–74 years. While women can attend for

**Table 2.** Demographic, Screening Episode, and Tumor Characteristics at BreastScreen Sydney West 2018–2021, by Year and COVID Grouping (Pre-COVID or COVID-affected) to be continued…

| | | 2018 Total (%) | 2019 Total (%) | Total Pre-COVID Total (%) | 2020 Total (%) | 2021 Total (%) | Total COVID Total (%) | Year-on-year P-value* | Pre-COVID vs COVID-affected P-value** |
|---|---|---|---|---|---|---|---|---|---|
| Demographic data | | | | | | | | | |
| Age | <50 | 3300 (6.9) | 3287 (6.9) | 6587 (6.9) | 2514 (5.8) | 2091 (6.1) | 4605 (5.9) | <0.001 | <0.001 |
| | 50–64 | 27880 (58.3) | 27117 (56.9) | 54997 (57.6) | 24325 (56.1) | 19685 (57.6) | 44010 (56.8) | 0.002 | |
| | 64–74 | 14866 (31.1) | 15233 (32.0) | 30099 (31.5) | 14698 (33.9) | 10808 (31.6) | 25506 (32.9) | <0.001 | |
| | >74 | 1788 (3.7) | 1996 (4.2) | 3784 (4.0) | 1787 (4.1) | 1602 (4.7) | 3389 (4.4) | <0.001 | |
| Indigenous Status | Non-Indigenous | 47341 (99.0) | 47149 (99.0) | 99490 (99) | 42902 (99.0) | 33702 (98.6) | 76604 (98.8) | 0.26 | 0.69 |
| | Aboriginal and/or Torres Strait Islander | 467 (1.0) | 469 (1.0) | 936 (1.0) | 390 (0.9) | 354 (1.0) | 744 (1.0) | | |
| Primary Language† | English | 32040 (67.0) | 31762 (66.7) | 63802 (66.8) | 28704 (66.3) | 22785 (66.7) | 51489 (66.4) | 0.08 | 0.10 |
| | Non-English | 15794 (33.0) | 15871 (33.3) | 31665 (33.2) | 14620 (33.7) | 11401 (33.3) | 26021 (33.6) | | |
| Screening episode data | | | | | | | | | |
| Interval from last screen | Mean (SD), years | 2.00 (0.06) | 2.00 (0.06) | N/A | 2.00 (0.07) | 2.00 (0.07) | N/A | N/A | N/A |
| Screening round | 1 | 7769 (16.2) | 7708 (16.2) | 15477 (16.2) | 4801 (11.1) | 5284 (15.5) | 10085 (13.0) | <0.001 | <0.001 |
| | 2 | 7009 (14.7) | 6357 (13.3) | 13366 (14.0) | 5787 (13.4) | 4549 (13.3) | 10336 (13.3) | <0.002 | |
| | ≥3 | 33056 (69.1) | 33568 (70.5) | 66624 (69.8) | 32736 (75.6) | 24353 (71.2) | 57089 (73.7) | <0.001 | |
| Initial recommendation | Routine re-screen, no symptom | 42922 (89.9) | 42688 (89.7) | 85610 (89.7) | 39127 (90.4) | 30732 (90.0) | 69859 (90.2) | 0.38 | <0.001 |
| | Routine re-screen, with symptom | 2599 (5.4) | 2632 (5.5) | 5231 (5.5) | 2404 (5.6) | 1975 (5.8) | 4379 (5.7) | 0.006 | |
| | Recall for assessment | 2279 (4.8) | 2283 (4.8) | 4562 (4.8) | 1769 (4.1) | 1457 (4.3) | 3226 (4.2) | <0.001 | |
| Assessment Result following recall | Early Review | 2 (0.5) | 3 (0.8) | 5 (0.7) | 3 (0.9) | 0 (0.0) | 3 (0.5) | 3.23 | 0.78 |
| | Diagnostic open biopsy | 62 (16.5) | 60 (16.5) | 122 (16.5) | 54 (16.0) | 39 (13.9) | 93 (15.0) | 2.24 | |
| | Further assessment | 20 (5.3) | 26 (7.2) | 46 (6.2) | 16 (4.7) | 17 (6.0) | 33 (5.3) | 2.39 | |
| | Routine screening at 2 years | 3 (0.8) | 1 (0.3) | 4 (0.5) | 1 (0.3) | 4 (1.4) | 5 (0.8) | 2.74 | |
| | Treatment | 288 (76.8) | 273 (75.2) | 561 (76.0) | 264 (78.1) | 221 (78.6) | 485 (78.4) | 1.54 | |

**Table 2.** Demographic, Screening Episode, and Tumor Characteristics at BreastScreen Sydney West 2018–2021, by Year and COVID Grouping (Pre-COVID or COVID-affected) continued

| | | 2018 Total (%) | 2019 Total (%) | Total Pre-COVID Total (%) | 2020 Total (%) | 2021 Total (%) | Total COVID Total (%) | Year-on-year P-value* | Pre-COVID vs COVID-affected P-value** |
|---|---|---|---|---|---|---|---|---|---|
| Final outcome | Diagnostic open biopsy | 0 (0.0) | 0 (0.0) | 0 (0.0) | 1 (0.0) | 0 (0.0) | 1 (0.0) | 1.87 | 0.22 |
| | Early review | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 2 (0.0) | 2 (0.0) | 0.82 | |
| | Further assessment | 0 (0.0) | 1 (0.0) | 1 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 2.58 | |
| | Routine re-screen at 1 year | 165 (0.3) | 178 (0.4) | 343 (0.4) | 138 (0.3) | 102 (0.3) | 240 (0.3) | 0.53 | |
| | Routine re-screen at 2 years | 47252 (99.0) | 47059 (99.0) | 94311 (99.0) | 42835 (99.0) | 33787 (99.0) | 76622 (99.0) | 5.19 | |
| | Treatment | 316 (0.7) | 309 (0.6) | 625 (0.7) | 284 (0.7) | 247 (0.7) | 531 (0.7) | 3.13 | |
| Imaging and assessment features of malignant lesions | | | | | | | | | |
| Tumour size (invasive)‡ | Mean (SD), mm | 18.15 (15.96) | 17.52 (13.19) | 17.83 (14.60) | 18.37 (14.80) | 19.09 (20.65) | 18.68 (17.58) | 0.73 | 0.37 |
| Tumour size (DCIS) ‡ | Mean (SD), mm | 21.03 (21.00) | 22.70 (21.63) | 21.84 (21.30) | 63.50 (21.77) | 26.42 (27.36) | 46.42 (24.34) | 0.05 | 0.11 |
| T-stage on imaging | TIS: In situ | 61 (20.1) | 52 (16.9) | 113 (18.5) | 46 (16.6) | 57 (24.3) | 103 (20.1) | 1.93 | 0.24 |
| | T1: 20 mm | 178 (58.6) | 189 (61.4) | 367 (60.0) | 160 (57.8) | 127 (54.0) | 287 (56.1) | 0.75 | |
| | T2: >20 mm–50 mm | 50 (16.4) | 59 (19.2) | 109 (17.8) | 64 (23.1) | 45 (19.1) | 109 (21.3) | 0.57 | |
| | T3: >50 mm | 15 (4.9) | 8 (2.6) | 23 (3.8) | 7 (2.5) | 6 (2.6) | 13 (2.5) | 0.98 | |
| Biopsy of axilla (FNA or core) | Yes | 6 (50) | 5 (56) | 11 (52) | 6 (75) | 8 (62) | 14 (64) | 0.73 | 0.46 |
| | No | 6 (50) | 4 (44) | 10 (48) | 2 (25) | 6 (38) | 8 (36) | | |
| Axillary biopsy result¶ | Malignant | 2 (40) | 3 (60) | 5 (50) | 2 (50) | 3 (38) | 5 (42) | 0.72 | 1.00 |
| | Not malignant | 3 (60) | 2 (40) | 5 (50) | 2 (50) | 5 (62) | 7 (58) | | |
| Palpability# | Palpable abnormality | 167 (26) | 169 (30) | 336 (28) | 157 (30) | 114 (21) | 271 (26) | <0.001 | 0.09 |
| | No palpable abnormality | 465 (73) | 381 (68) | 846 (72) | 360 (69) | 425 (78) | 785 (74) | | |

FNA, fine needle aspiration; core, core needle biopsy.
* Comparison between 2018, 2019, 2020, and 2021
** Comparison between 'Total pre-COVID' (2018 and 2019 combined) and 'Total COVID' (2020 and 2021 combined)
† Main language spoken at home.
‡ Imaging size for 'most significant lesion' if multiple lesions were present.
¶ Two cases with unknown biopsy results were excluded.
# Palpability refers to findings on clinical examination at the time of assessment.

free screening from age 40 on request, they do not receive a letter of invitation until age 50. Therefore, younger women may have viewed screening as non-essential during the pandemic and chosen not to attend during this time. Targeting women aged 40–50 for catch-up screening could be viewed as less urgent. The other demographic groups that showed trends towards significance, such as socioeconomic decile and country of birth, were inconsistent and did not provide concrete guidance on groups to target for catch-up screening. Notably, there was no reduction in attendance among women who spoke languages other than English. This group was particularly vulnerable during the pandemic as health messaging did not always reach diverse cultural groups. In general, they are less likely to attend for screening.[2,12] International research has shown an increase in the proportion of later-stage cancers detected during COVID-affected years.[5] This was not demonstrated in the present study. Rather, there was a nonsignificantly higher proportion of DCIS cases (compared to invasive cancer) in the COVID-affected years (20% and 17% pre-COVID and 17% and 24% COVID-affected, P = 0.48).

The reason for this finding is unclear, and correlation with future data on DCIS and invasive cancer diagnoses is needed to further evaluate this. There was no difference in T-stage for invasive tumors, which is not consistent with predictions of a shift to later-stage cancer during the pandemic.[1]

This study has some strengths and limitations. The predominant strength is the large data set that includes details of demographics, assessment data, and imaging information. The main limitation is that the data are limited to information related to the screening episode and do not include detailed surgical pathology or treatment data. Tumor size analysis was based on imaging size, and this can differ from surgical histology. Increasingly, however, imaging size is used for cases undergoing neoadjuvant chemotherapy rather than up-front surgery. The results of this study have limited generalizability because the multicultural nature of the population and the COVID-related restrictions and lockdowns are unique to the geographical area. Despite this, universal themes have emerged that make the experience relatable to different jurisdictions, particularly in Australia and countries with similar population screening programs. This study is cross-sectional, so long-term data are needed to examine the effect of the pandemic and the change in screening behavior on future cancer diagnosis and mortality.

## CONCLUSION

This study demonstrated a significant reduction in screening attendance during 2020 and 2021 due to the COVID-19 pandemic. Younger women and first-time screening attendees were the groups less likely to attend during these years. This is the only demographic group that has been identified as needing focused recruitment strategies for catch-up screening. Quality indicators such as cancer detection rate and recall rate were maintained despite the challenges during this time. The observed increase in the proportion of DCIS cases, compared to invasive cancer, is of unknown clinical significance. Future evaluation to map these indicators is needed as the recovery from the pandemic continues. The service must be prepared to increase screening numbers to diagnose the cases of breast cancer that were not seen during the pandemic, and acknowledge that some of these will be later-stage at diagnosis. Close coordination with treatment services is needed, as some of these patients will present with symptomatic cancers and will not be seen through the screening program.

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None.

## CONFLICTS OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. All authors confirm that there are no conflicts of interest, financial or otherwise, that could be perceived as having influenced the content or outcome of this study.

## ETHICAL CONSIDERATIONS

Ethics approval was obtained from the Western Sydney Local Health District (WSLHD) Human Research Ethics Committee (Quality Assurance project 2206-01 NGUI) and The University of Notre Dame Australia Human Research Ethics Committee (Cross-Institutional approval 2022-095S). Approval was obtained from the Cancer Institute NSW, the custodian of the BreastScreen data, prior to the release of the data.

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## DATA AVAILABILITY

Data can be accessed by contacting the corresponding author.

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