Impact of the COVID-19 pandemic on the breast cancer early diagnosis program in Brazil

Marcelo Antonini [a,b,1,*], Denise J.P. da C. Pinheiro [a,2], Ana B.T. de M.B. Matos [a,3], Odair Ferraro [a,4], Andre Mattar [c,5], Lucas M. Okumura [d,6], Reginaldo G.C. Lopes [a,b,7], Juliana M. Real [b,8]

[a] Hospital do Servido Publico Estadual – Francisco Morato Oliveira (HSPE-FMO), São Paulo, Brazil
[b] CEDEP – Instituto de Assistència Médica ao Servidor Público Estadual (IAMSPE), Sao Paulo, Brazil
[c] Hospital Perola Byington, São Paulo, Brazil
[d] ValueArchTech, São Paulo, Brazil

A B S T R A C T

During the COVID-19 pandemic, several screening exams were postponed, including mammograms. The aim of this study was to evaluate the impact of COVID-19 in mammographic screening in Brazil, considering 2015 to 2021. This was descriptive ecologic study based on the retrospective data of Brazil's mammographic screening program. A Brazilian national screening database (DATASUS – SISCAN (Cancer System Information)) was used as the data source, and the data in this database are publicly available for download and analysis. We report the number of screening rate from January 2015 to December 2021, using 2020 as reference year for COVID-19. From 2015 to 2021, 10,763,894 mammograms were performed and included in the analysis. Reductions of 39.6% and 13.3% were found in 2020 in 2021, respectively. During the pandemic's peak, the reduction was more pronounced, with maximum reductions of 82.4% in May 2020 and 34.8% in April 2021. There was an increase in the number of mammograms performed on high-risk patients from 11.2% in 2020 to 13.9% in 2021. This research demonstrated a decline in the breast cancer screening rate during the two years of the COVID-19 pandemic; this reduction will increase the burden of advanced breast cancer, potentially impacting morbidity and mortality related to this neoplasm.

1. Introduction

Coronavirus disease 2019 (COVID-19) has rapidly spread globally since 2019 December 31.[1] National lockdown at the beginning of the COVID-19 pandemic contributed to a decrease in breast cancer screenings compared to 2019. (Maringe et al., 2020) These postponed screenings have led to an increase in undiagnosed breast cancer cases that health systems will need to address in the future. (Maringe et al., 2020) As healthcare facilities expand access to preventive services, providers will need to develop and adopt new processes and protocols to address the burden imposed by lack of screening so that delayed breast cancer diagnoses will not significantly impact morbidity and mortality

in healthcare systems. (Maringe et al., 2020) The prediction of an increase in the prevalence of advanced cases with possible impacts on mortality is of great concern. Health centers need to develop and adopt new processes and protocols to address the breast cancer screening backlog and minimize associated damage.

Breast cancer is the leading cause of cancer-related death among women in Brazil. It is ranked fifth among all causes of death (preceded by heart attack, pneumonia, diabetes, and chronic obstructive pulmonary disease). (da Saúde and (br), datasus, 2022) Breast cancer is the most frequently diagnosed cancer in women worldwide; excluding nonmelanoma skin tumors, according to 2020 Global Cancer Statistics data. Approximately 2.3 million new cases were identified in 2020,

accounting for 11.7 % of all cancer diagnoses worldwide among men and women of all ages and 685,000 deaths. (Sung et al., 2021) Breast cancer represents 24.5 % of all new female cancers; and 15.5 % of all death causes each year. (Sung et al., 2021) In addition, this disease has the highest cumulative risk in women over 74 years of age. (Sung et al., 2021) In Brazil, the National Cancer Institute (INCA) estimated 66,280 new cases of breast cancer in 2020, accounting for 29.7 % of all cancer diagnoses in women. (Nacional and de Câncer José Alencar Gomes da Silva: Estimativa, 2020) Breast cancer is a considerable public health burden, and primary and secondary prevention measures require strengthening globally. (IARC, 2020).

Early detection can reduce mortality and the intensity of treatment required.[7] Delays in diagnosis and the treatment of breast cancer due to the pandemic are expected to lead to more intensive (aggressive and mutilating) treatment requirements and, potentially, increased mortality. (Kregting et al., 2021).

The Brazilian national guidelines for early breast cancer detection, established in 2004 by the INCA, were updated in 2015 by the Brazilian National Institute of Cancer and now recommend that all women aged 50–69 years undergo mammography screening every 2 years. (Instituto Nacional de Câncer José Alencar Gomes da Silva, 2015) The Brazilian College of Radiology and Imaging Diagnosis, together with the Brazilian Society of Breast Disease and the Brazilian Federation of Associations of Gynecology and Obstetrics, recommend annual mammography screening in women aged 40 to 74 years, preferably with a digital technique (category A – strong evidence). These same societies recommend preferably digital mammographic screening after the age of 75 years in women with a life expectancy greater than seven years, based on comorbidities (category D – expert consensus), and they recommend that annual screening should start at the age of 30 years in women with high risk. (Urban et al., 2017).

The aim of this study was to evaluate the impact of COVID-19 pandemics on mammographic screening in Brazil, considering a 7-year horizon (2015 to 2021) rate.

2. Methods

This was an ecologic observational study based on retrospective data from a mammographic screening program in Brazil. A Brazilian national screening database (DATASUS – SISCAN (Cancer System Information)) was used as the data source, and the data is publicly available for download and analysis. Data was downloaded in February 2022, so, by that time, 2021 was the last complete year reported in the database.

The key inclusion criteria for the study were as follows: presenting information about mammogram (if there was any missing data, we excluded the registry); participants aged 50 to 69 years old; and mammograms performed for only screening purposes. The number of mammograms performed in the aforementioned period was evaluated, considering BIRADS® test results. As a descriptive study, there is no specific hypothesis to be tested. So, no statistical test was performed. Data were analyzed as follows: (a) absolute number of mammograms performed per year; (b) comparison of 2019, 2020 and 2021 screening mammograms; (c) mammograms per year according to risk (family history and previously treated breast cancer); (d) percentage distribution of mammograms per month and year.

3. Results

From 2015 to 2021, 17,300,523 mammograms were performed in all age groups, of which 422,596 were classified as diagnostic mammograms and 16,877,927 as screening exams. Of these screening mammograms, 6,114,033 were performed in an age group not compatible with the screening program of the Ministry of Health, 50–69 years. According to the study inclusion criteria, from 2015 to 2021, a total of 10,763,894 mammograms were included for analysis.

Table 1 shows the distribution of examinations performed from 2015 to 2021. A significant reduction in the number of examinations performed in 2020 and 2021, which corresponds to the pandemic period, was observed. In addition, between 2015 and 2019, there was a gradual increase in the number of screening mammograms, so the expectation of examinations conducted between 2020 and 2021 should be increased. The reduction in 2020 was 39.6 %; however, in 2021, the reduction decreased to 13.3 %.

Fig. 1 shows the graph of examinations performed from 2015 to 2021, as well as the projection of examinations for 2020 and 2021 if there was an increase in the number of mammograms performed following the proportions of the years before the pandemic.

Table 2 shows the analysis of the reduction in the number of mammograms performed in 2020 and 2021 compared to those performed in 2019. This table demonstrates reductions of 39.6 % in 2020 and 13.3 % in 2021. At the peak of the pandemic, the reduction was more pronounced in 2020, with a maximum reduction of 82.4 % in May 2020 and 34.8 % in April 2021, compared to the same month in 2019.

Monthly data for 2017 to 2021 was obtained. Fig. 2 shows a decrease in the number of mammograms performed in 2020 and 2021, mainly in the initial months of the pandemic in 2020, between March and May, and in 2021, the lower number of examinations was maintained until April, with a gradual subsequent increase. We observed an increase in the number of mammograms performed in October and November.

In the evaluation of the distribution of mammograms performed in relation to patient risk characteristics, it was observed that in 2020–2021, there was an increase in the percentage of mammograms performed in high-risk patients, including those with family history or undergoing follow-up for previous breast cancer.

Analysis of the percentages of mammograms performed in 2020 showed a concentration of exams performed in the first and fourth quarters and a reduction in the number of mammograms performed in the second and third quarters, as shown in Table 3.

Table 4 shows the distribution of these mammograms, and the high-risk population accounted for 4.0 % and 4.1 % in 2020 and 2021, respectively, from all mammograms performed in those years. When compared with the averages for 2015–2019 (3.6 %), we observed increases of 11.2 % and 13.9 %, respectively.

Fig. 3 shows the percentages of patients with confirmed COVID-19 in Brazil, considering the national population. In 2020, we observed an increase in the number of cases from April to August and a subsequent small reduction until October. The number of COVID-19 cases in 2020 showed a similar trend to the reduction in mammography examinations. Regarding the evolution of the pandemic in 2021, a reduction in the number of cases of COVID-19 with an increase in screening mammograms from June was observed.

Table 1
Mammographic screening in Brazil in women with 50 to 69 years old.

	2015	2016	2017	2018	2019	2020	2021	Total
Mammograms	1,185,401	1,334,415	1,686,704	1,778,484	1,933,952	1,168,602	1,676,283	10,763,841
%	11.0	12.4	15.7	16.5	18.0	10.9	15.6	100

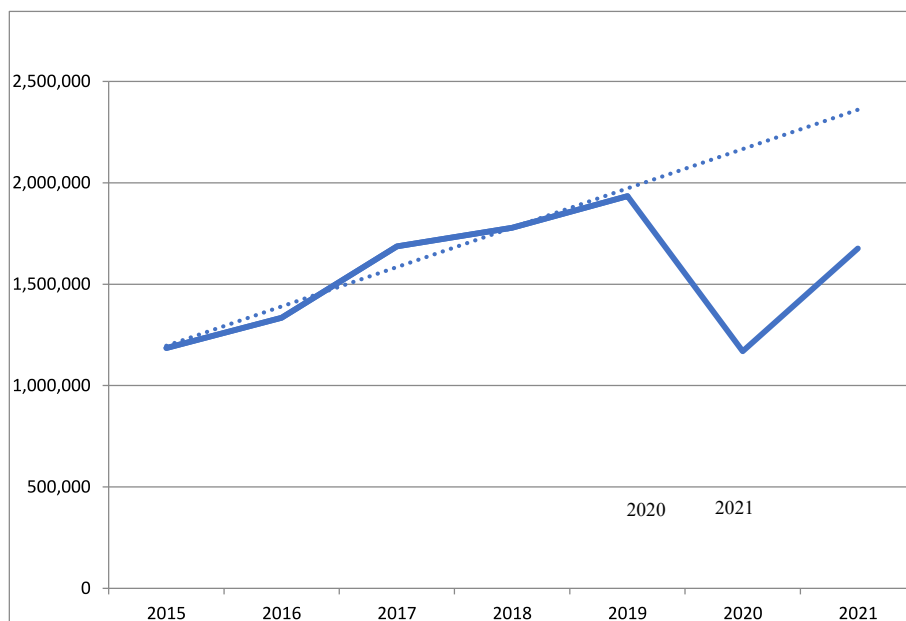Source: DATASUS – SISCAN, accessed on 02/02/2022.

Fig. 1. Comparison of examinations carried out in the period 2015–2021 and the projection of examinations if the pandemic did not occur. Source. DATASUS – SISCAN accessed on 02/02/2022.

Table 2
Variation in the number of mammograms performed in Brazil from 2019 to 2021.

	2019	2020	% Variation	2021	% Variation
January	149,194	152,720	2,4%	119,461	−19,9%
February	151,136	142,730	−5,6%	118,747	−21,4%
March	143,773	134,458	−6,5%	119,773	−16,7%
April	153,265	36,920	−75,9%	99,971	−34,8%
May	154,093	27,062	−82,4%	114,437	−25,7%
June	139,076	36,709	−73,6%	117,110	−15,8%
July	146,590	47,186	−67,8%	128,587	−12,3%
August	152,198	57,146	−62,5%	142,078	−6,6%
September	156,636	78,279	−50,0%	143,435	−8,4%
October	212,465	140,046	−34,1%	182,790	−14,0%
November	198,356	169,014	−14,8%	208,779	5,3%
December	177,170	146,332	−17,4%	181,115	2,2%
Total	1,933,952	1,168,602	−39,6%	1,676,283	−13,3%

Source. DATASUS – SISCAN accessed on 02/02/2022.

Table 3
Percentual distribution of mammograms through months in a given year.

Month	2017	2018	2019	2020	2021
January	6,5	8,0	7,7	13,1	7,1
February	6,1	6,8	7,8	12,2	7,1
March	7,6	8,1	7,4	11,5	7,1
April	6,9	8,0	7,9	3,2	6,0
May	8,5	8,0	8,0	2,3	6,8
June	8,1	7,4	7,2	3,1	7,0
July	8,2	7,4	7,6	4,0	7,7
August	8,8	8,4	7,9	4,9	8,5
September	8,2	7,4	8,1	6,7	8,6
October	10,2	10,5	11,0	12,0	10,9
November	10,7	11,1	10,3	14,5	12,5
December	10,2	9,0	9,2	12,5	10,8
Total	100,0	100,0	100,0	100,0	100

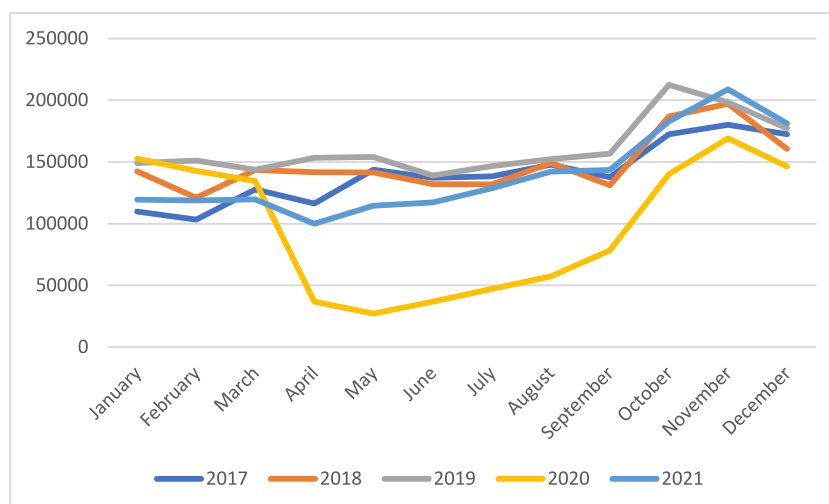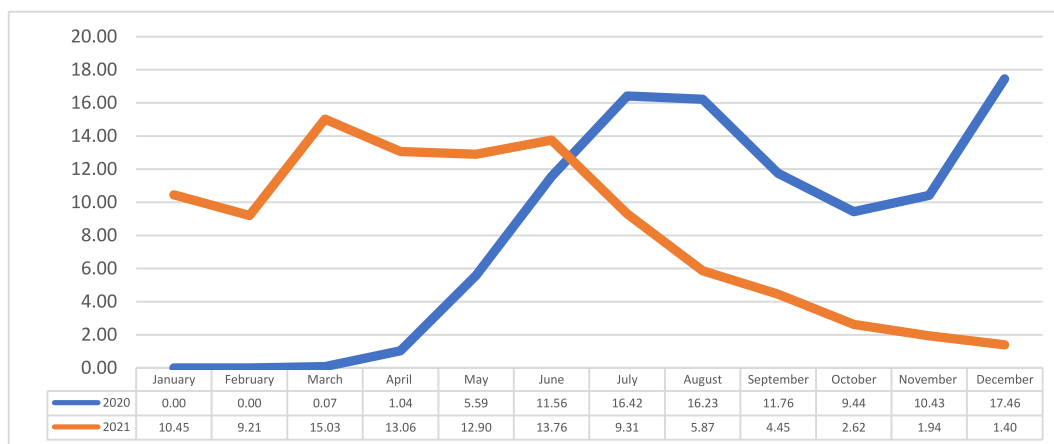Source: DATASUS – SISCAN, accessed on 02/02/2022.

Fig. 2. Monthly distribution of mammograms performed in 2015–2021. Source: DATASUS – SISCAN, accessed on 02/02/2022.

Table 4

Mammographic screening in Brazil in 2015–2021 according to risk.

	2015	2016	2017	2018	2019	2020	2021	Total
Total mammograms	1,987,293	2,142,143	2,559,576	2,725,750	2,967,865	1,803,449	2,535,712	16,721,788
50 to 69 years old	1,139,969	1,280,316	1,614,521	1,697,130	1,837,545	1,096,942	1,572,673	10,239,096
% of total	57.4	59.8	63.1	62.3	61.9	60.8	62.0	61.2
High Risks (family history	31,063	36,625	49,633	55,185	66,760	44,551	70,975	354,792
% of total	1.6	1.7	1.9	2.0	2.2	2.5	2.8	2.1
Previously treated BC	14,368	17,472	22,549	26,169	29,644	27,109	32,635	169,946
% of total	0.7	0.8	0.9	1.0	1.0	1.5	1.3	1.0

Source: DATASUS – SISCAN, accessed on 02/02/2022. Legends: BC (breast cancer). Observations: percentages are rounded numbers. Seven mammograms were excluded.

	January	February	March	April	May	June	July	August	September	October	November	December
2020	0.00	0.00	0.07	1.04	5.59	11.56	16.42	16.23	11.76	9.44	10.43	17.46
2021	10.45	9.21	15.03	13.06	12.90	13.76	9.31	5.87	4.45	2.62	1.94	1.40

Fig. 3. Percentage of confirmed COVID-19 cases among the total Brazilian population, from 2020 to 2021. Source: https://covid.saude.gov.br, 02.02.2022.

4. Discussion

This report describes the negative impact of COVID-19 in screening mammograms in Brazil. The findings of this study suggest that there was a delay in breast cancer diagnosis during the first year (2020) of the pandemic, which was not compensated for in the second year (2021). Breast cancer screening in the asymptomatic population leads to early diagnosis and treatment. The real impact of temporary mammographic screening suspension on breast cancer outcomes remains uncertain in asymptomatic women who skipped screening mammography during the COVID-19 pandemic. (Lauby-Secretan et al., 2015).

This study showed that the pandemic caused a 39.6 % reduction in the number of breast screening examinations performed in 2020 and a 13.3 % reduction in 2021. The findings of this study are remarkably consistent with those in the literature that report a reduced demand for health care during the pandemic, including emergency services during the first years of the pandemic. (Velazquez et al., 2021) Naidich et al. (Naidich et al., 2020) reported that the greatest decline in imaging volume during the pandemic was observed among outpatient imaging examinations (88 %), affecting all modalities, but the decline was highly pronounced in mammogram examinations (94 % less than that in 2019).

Tachibana et al. (Tachibana et al., 2021) and Bessa (Bessa, 2021) performed two different studies utilizing breast screening information; the first analyzed data from a private institution in Brazil, and the other analyzed data from a public screening program in Brazil. Both studies showed a reduction in the first year of the pandemic, with the reduction at the private institution being 78 % greater than previously reported numbers (39.6 %) (Tachibana et al., 2021; Bessa, 2021).

This study also revealed an interesting pattern that was not affected by the pandemic. Table 3 shows an increase in the number of mammograms performed in Brazil in the months of October and November from 2015 to 2021, with higher percentages in the two years of the pandemic (12 % and 10.5 %, respectively, when compared to 2019).

During this period, every year, Brazil celebrates "Pink October", a worldwide breast cancer awareness campaign highlighting the importance of early diagnosis through mammography. To minimize the impact of the reduction in breast cancer screening, it is important to promote campaigns that raise awareness of the importance of early diagnosis through mammography (Antonini et al., 2022).

Secondary prevention is the main strategy to reduce the increasing burdens of breast and prostate cancer. Regarding breast cancer, national estimates project that the COVID-19 pandemic will lead to an estimated deficit of 3.9 million breast cancer screenings among U.S. adults. (Velazquez et al., 2021) Patients who could have been diagnosed at an earlier cancer stage will be diagnosed at a more advanced stage due to the reduction in mammographic screening caused by the pandemic.

Patients who are directly impacted by COVID-19 are less likely to undergo screening due to the long-term impact of COVID-19 as well as the psychological stress of the disease. (Ong, 2020) With an increasing deficit in screening rates, it has been projected that the COVID-19 pandemic could potentially increase the mortality rates of breast cancer and colorectal cancer over the next 10 years. (Dennis et al., 2020).

The findings of this study suggest that there was a delay in breast cancer diagnosis during the first year (2020) of the pandemic, which was not compensated for in the second year (2021). Importantly, these findings connects with a systematic review with metanalysis that showed a significant decrease in breast cancer screening (-46.7 %). (Teglia et al., 2022).

We must consider delays in breast examinations in terms of not only how to return to the normal number of examinations but also how to mitigate the effects of delayed diagnoses.

The postponement of screening procedures as a result of the COVID-19 pandemic was prudent and appropriate at one time. However, the spread, duration and future peaks of COVID-19 are unpredictable and ignoring breast cancer and other life-threatening conditions for too long may turn one public health crisis into another.

This study has limitations related to observational studies such as risk for imprecisions in the registries and the inferences surrounding our findings. For example, we were not able to assess in the database the amount of women who should be screened (potential candidates).

5. Conclusion

This study showed a decline in breast cancer screening rates during the two years of the COVID-19 pandemic, and those reductions may increase the burden imposed by advanced breast cancer, potentially impacting morbimortality related to this neoplasm.

CRediT authorship contribution statement

Marcelo Antonini: Conceptualization, Data curation. **Denise J.P. da C. Pinheiro:** Conceptualization, Data curation. **Ana B.T. de M.B. Matos:** Conceptualization, Data curation. **Odair Ferraro:** . **Andre Mattar:** Supervision. **Lucas M. Okumura:** . **Reginaldo G.C. Lopes:** Supervision. **Juliana M. Real:** Conceptualization, Data curation.

Declaration of Competing 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.

Data availability

This study was based on publicly available anonymized databases

References

Antonini, M., Pinheiro, D.J.P.D.C., Salerno, G.R.F., Matos, A.B.T.M.B., Ferraro, O., Mattar, A., Lopes, R.G.C., Real, J.M., 2022. Does Pink October really impact breast cancer screening? Public health in practice (Oxford England) 4, 100316. https://doi.org/10.1016/j.puhip.2022.100316.

Bessa, J.F., 2021. Breast imaging hindered during covid-19 pandemic, in Brazil. Rev Saude Publica 55, 8.

Dennis LK, Hsu CH, Arrington AK: Reduction in standard cancer screening in 2020 throughout the U.S. Cancers (Basel) 13:5918, 2021.

IARC: Latest global cancer data: Cancer burden rises to 19.3 million new cases and 10.0 million cancer death in 2020 Questions and Answers (QA). 2021. https://www.iarc.who.int/faq/latest-global-cancer-data-2020-qa/.

Instituto Nacional de Câncer José Alencar Gomes da Silva: Diretrizes para a detecção precoce do câncer de mama no Brasil. Rio de Janeiro, INCA, 2015.

Kregting, L.M., Kaljouw, S., de Jonge, L., et al., 2021. Effects of cancer screening restart strategies after COVID-19 disruption. Br J Cancer 124, 1516–1523.

Lauby-Secretan, B., Scoccianti, C., Loomis, D., et al., 2015. Breast-cancer screening–viewpoint of the IARC Working Group. N Engl J Med 372, 2353–2358.

Maringe, C., Spicer, J., Morris, M., et al., 2020. The impact of the COVID-19 pandemic on cancer deaths due to delays in diagnosis in England, UK: a national, population-based, modelling study. Lancet Oncol 21, 1023–1034.

Ministério da Saúde (BR), DATASUS: Informações em saúde: mortalidade - Brasil. 2022. http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sim/cnv/obt10uf.def.

Instituto Nacional de Câncer José Alencar Gomes da Silva: Estimativa 2020: Incidência de Câncer no Brasil. Rio de Janeiro, INCA, 2019.

Naidich, J.J., Boltyenkov, A., Wang, J.J., et al., 2020. Impact of the coronavirus disease 2019 (COVID-19) pandemic on imaging case volumes. J Am Coll Radiol 17, 865–872.

Ong, M., 2020. Sharpless: COVID-19 expected to increase mortality by at least 10,000 deaths from breast and colorectal cancers over 10 years. Cancer Lett 46, 5–10.

Sung, H., Ferlay, J., Siegel, R.L., et al., 2021. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin 71, 209–249.

Tachibana, B.M.T., Ribeiro, R.L.M., Federicci, É.E., et al., 2021. The delay of breast cancer diagnosis during the COVID-19 pandemic in São Paulo, Brazil. Einstein (Sao Paulo) 19, eAO6721.

Teglia, F., Angelini, M., Astolfi, L., et al., 2022. Global Association of COVID-19 Pandemic Measures With Cancer Screening: A Systematic Review and Meta-analysis. JAMA Oncol. 8 (9), 1287–1293. https://doi.org/10.1001/jamaoncol.2022.2617.

Urban LABD, Chala LF, Bauab SdP, et al: Recomendações do colégio Brasileiro de radiologia e diagnóstico por imagem, da sociedade Brasileira de mastologia e da federação Brasileira das associações de ginecologia e obstetrícia para o rastreamento do câncer de mama. Radiol Bras 50:244-249, 2017.

Velazquez, A.I., Hayward, J.H., Gregory, B., et al., 2021. Trends in breast cancer screening in a safety-net hospital during the COVID-19 pandemic. JAMA Netw Open 4, e2119929.