

Social health determinants associated with mammography performance according to the 2013 and 2019 National Health Survey

Denise Montenegro da Silva (<https://orcid.org/0000-0001-6969-4133>)¹
Yanka Alcântara Cavalcante (<https://orcid.org/0000-0003-0152-9216>)¹
Bruno Luciano Carneiro Alves de Oliveira (<https://orcid.org/0000-0001-8053-7972>)²
Marcos Venícios de Oliveira Lopes (<https://orcid.org/0000-0001-5867-8023>)¹
Ana Fátima Carvalho Fernandes (<https://orcid.org/0000-0001-5110-6364>)¹
Ana Karina Bezerra Pinheiro (<https://orcid.org/0000-0003-3837-4131>)¹
Priscila de Souza Aquino (<https://orcid.org/0000-0003-4976-9817>)¹

Abstract Mammography is one of the main methods available for breast cancer screening in Brazil. However, differences in timely access and performance of the exam can be highlighted based on social determinants of health, considered relevant due to their influence on the health situation of a population. Thus, the present study aimed to identify the social determinants of health associated with access to and performance of mammography in Brazilian women. Cross-sectional and analytical study, based on secondary data from the National Health Survey (NHS) from 2013 and 2019 in Brazil. The main determinants of women who did not take the exam during the evaluated period were: aged 65 to 69 years, mixed race and black, living with more than three people, with incomplete primary education, in the 1st quintile of socioeconomic income, without health insurance, registered with the Family Health Strategy (FHS), and residents of the North and Northeast regions. There was a significant improvement in access to mammography exams in all states; however, structural factors, such as economic income, color, level of education, and age group were evident in why mammograms were not performed.

Key words Social determinants of health, Mammography, Breast neoplasms, Health promotion, Brazil

¹ Universidade Federal do Ceará. R. Alexandre Baraúna 1115, Rodolfo Teófilo. 60430-160 Fortaleza CE Brasil. denisemontenegrodasilva@gmail.com

² Universidade Federal do Maranhão. São Luís MA Brasil.

Introduction

As a result of rapid population growth and aging, the incidence and mortality of cancer have increased considerably, making it an important pathology of public health interest. Globally, one in every six deaths is related to cancer, and approximately 70% of all deaths occur in low- and middle-income countries¹.

For breast cancer, in 2020, 2.3 million women were diagnosed and 685,000 deaths were reported worldwide. By the end of 2020, there were 7.8 million women alive who had been diagnosed with breast cancer in the last 5 years, making it the most prevalent condition in the world². Incidence estimates in Brazil for the 2020-2022 triennium period included 66,280 new cases of breast cancer. These data reveal an estimated risk of 61.61 new cases for every 100,000 women, which reinforces the magnitude of the problem in the country³.

Screening and diagnostic methods allow healthcare professionals to offer personalized treatments that improve outcome and survival. Mammography is a low-dose x-ray modality for detailed images of the breast, and is the most effective population-based screening method⁴. It has a significant impact on reducing breast cancer mortality, as women who participate in mammographic screening are able to detect certain changes earlier and benefit from less aggressive therapies⁵. Furthermore, the main benefits of screening are the reduction in mortality from breast cancer, years of life lost due to breast cancer, and morbidity from breast cancer treatment⁶.

When breast cancer is detected and treated early on, the chances of survival are high. However, women in many settings face complex barriers to early detection. Factors, such as the lack of marital status, high educational levels, being a non-smoker, and having had more than two pregnancies influence both breast self-examination and mammography examinations. This study also addressed the impact of economic inequality on mammography⁷.

These barriers correspond to the Social Determinants of Health (SDH), defined as “the circumstances in which people are born, grow, work, live and age, and the broad set of forces and systems that shape the conditions of everyday life”⁸.

What these SDH tend to cause may influence accessibility to health services, which includes access to and performance of a mammography. A literature review carried out on the

barriers that affect adherence to breast cancer screening in vulnerable populations identified common barriers, such as race/ethnicity (47%), low socioeconomic status (35.3%), education (29.4%), lack of family history of cancer and being single (29.4%), distrust of health care and lack of health information (23.5%), lack of private health insurance (17.6%), and not having an annual health check-up (17.6%). The target populations with the lowest adherence were black, Asian, Hispanic and foreign women⁹.

The SDH can highlight differences in access to timely health services and can be considered relevant in the analysis of women who do or do not have a mammogram. One study identified the expansion of coverage of the Family Health Strategy (FHS) in almost all states of the country, however, with inequalities in terms of mammograms available in different regions. Supplementary health had a greater impact than did the FHS, since mammograms are mostly provided in the private health system. Thus, inequality in the distribution of mammograms is a major obstacle to equity in access to the exam¹⁰.

Precarious access to adequate and timely diagnosis and treatment leads to the arrival of patients in more advanced stages of breast cancer, which worsens the prognosis. In this sense, Ivanova and Kvaalem¹¹ addressed the need for future health promotion campaigns focused on two health behaviors, namely: the psychological factors that influence the decision to undergo the exam and the factors that contribute to the decision of certain women to avoid the exam itself.

The importance of investigating SDH associated with mammography is highlighted, which is the peak of the debate in this article. In this sense, the National Health Survey (NHS), a national survey conducted in 2013 and 2019, provides data that enable the establishment of consistent measures, constituting an important subsidy for the formulation of public policies in the areas of promotion, surveillance and care provided to the Unified Health System (SUS). Thus, the aim of this study was to identify the social determinants of health associated with access to and performance of a mammography in Brazilian women according to the 2013 and 2019 NHS.

Methods

This is a cross-sectional study based on secondary data collected from the 2013 and 2019 NHS.

The NHS data are public data made available in microdata format. Therefore, we had access to the complete database, variable dictionaries, and applied questionnaires. The data regards the individual as the unit of analysis and not the household. Even though they are collected based on household selection, data were adopted in which the last selection unit was the woman (selected resident). NHS microdata require no sophisticated techniques for their use. The NHS was carried out by the Brazilian Institute of Geography and Statistics (IBGE) in partnership with the Ministry of Health (MH) and the Oswaldo Cruz Foundation^{12,13}.

The NHS is a population-based, nationwide household survey that collected a broad set of life and health indicators. The NHS 2013 target population was made up of individuals ≥ 18 years of age, while the 2019 NHS population consisted of individuals ≥ 15 years of age, residing in permanent private homes in Brazil. Questions were asked about the households and all their residents. A third part was applied to a resident ≥ 18 years of age (in 2013) and ≥ 15 years of age (in 2019), randomly selected among all residents of the previously selected household¹²⁻¹⁴.

The NHS uses a complex probabilistic sample of a set of units from selected areas of all states in Brazil. The sampling used was probabilistic by conglomerates in three stages of selection, with a stratification of Basic Health Units (BHUs) (census sectors or a set of sectors). The households represent the secondary units and the tertiary unit represents the resident (≥ 18 years of age in 2013 and ≥ 15 years of age in 2019), who responds to the individual portion of the questionnaire applied in each NHS. Further methodological details can be obtained in NHS publications¹²⁻¹⁴.

The model adopted for categorizing and discussing the variables was the Social Determination Model of Solar and Irwin¹⁵, also referenced by the World Health Organization (WHO) as a conceptual framework for the SDH. This model is structured according to two organized topics: a) Structural determinants of health inequities, which were considered the NHS variables: age (age group), educational level, race, income (income quintile), city of residence (capital or interior); b) Intermediate determinants of health, categorized into: health plan (yes or no), registration at the family health unit (yes or no).

In 2013, the median income at the lowest level was 236.00 reais and at the highest lev-

el 3,644.00 reais. In 2019, the median income at the lowest level was 358.00 reais and at the highest level 5,100.00. The macro-region of residence in the country (North, Northeast, Midwest, Southeast, and South) was also used, as were the state capitals. Brazil is made up of 26 states and a Federal District, each of which has a capital that represents it.

In the NHS, data were collected from Brazilian capitals and countryside towns in 2013 and 2019 so as to monitor the evolution of variables. The variable medical request for a mammography was considered to be an outcome variable, which was associated with the other variables. For the present study, women, aged between 50 and 69 years and eligible for a mammography, were included, according to the National Cancer Institute (INCA), an auxiliary body of the MH¹⁶.

For both years of the NHS, the prevalence ratios of those exposed to a condition of interest in relation to the total, overall, or group population under analysis and their 95% confidence intervals (95%CI) for not undergoing a mammography were estimated according to the socioeconomic and demographic variables and the capitals of Brazilian states. For such estimates, the following variables were adopted: Weight of the selected resident (unequal selection probabilities), Primary selection unit (conglomerate), and Strata (census sectors).

In all analyses, differences were considered statistically significant at the 5% level in the absence of overlapping 95% CIs. Crude and adjusted Poisson regression analyses were performed to estimate prevalence ratios (PR) and respective 95%CI of the association of socioeconomic and demographic variables with the non-performance of a mammography in 2013 and 2019. Pearson's Chi-Square test was used with the *svy* command, which for a long time, had a Rao-Scott approximation for complex data. All analyses were carried out using RStudio software version 2022.7.2.576 (R Foundation for Statistical Computing, Boston, United States of America) and incorporate all the characteristics of the complex sampling plan of NHS 2013 and 2019.

The NHS 2013 (opinion no. 328,159) and 2019 (opinion no. 3,529,376) projects were approved by the National Research Ethics Commission (CONEP)/National Health Council (CNS), and all participants signed a free and informed consent form^{13,14}.

Results

In the 1st edition of the NHS in 2013, 8,539 women who answered questions regarding mammography participated in the study, as compared to 14,795 women in 2019, revealing an increase in the proportion of women interviewed between one year and the next. Figure 1 shows the prevalence of not taking the exam according to the Federal Units of the Union according to the age group of 50 to 69 years of age established in the present study.

In 2013, the states with the highest prevalence of non-performance of a mammography were: Acre (63%), Maranhão (60%), Pará (58%), Tocantins (56%), Piauí (55%), and Rondônia (55%), notably states in the North and Northeast regions. It is important to note that other states in these regions also achieved higher rates of the non-performance of a mammography when compared to other regions, such as: Amapá and Rondônia of the North region; and Ceará, Paraíba, and Piauí of the Northeast region. During 2019, the states with a high prevalence of non-completion of mammography were: Amapá (53%), Acre (47%), Pará (46%), Roraima (45%), and Maranhão (44%), also belonging to the North and Northeast regions. Other states, such as Ceará, Pernambuco and Alagoas from the Northeast region, and Tocantins from the North region, were evaluated as having the highest rates for non-performance after the previously mentioned states.

When comparing the rates of the non-performance of a mammography between the years 2013 and 2019, a significant difference was observed in the states of Rondônia, Tocantins, Bahia, Paraíba, Piauí, Goiás, Mato Grosso do Sul and Rio de Janeiro, as well as in the data from Brazil in general. In this way, there is an improvement in access to mammography exams both nationally and in the states.

The five states that had the lowest rates of non-performance of mammography exams are from the Southeast regions (São Paulo and Rio de Janeiro), South (Rio Grande do Sul), and Midwest (Minas Gerais and Federal District), which suggests that the better living conditions in these regions lead to a lower prevalence of failure to undergo a mammography.

Table 1 covers the comparison of the prevalence of failure to undergo a mammography according to the SDH of women in 2013 and 2019.

When comparing the prevalence of not undergoing a mammography exam in 2013 and 2019, it was found that the structural deter-

minants of health inequities had differences in prevalence over the years, with a clear increase in access to this exam, with the exception of age, which showed no statistical difference. Although the frequencies showed a decrease in the non-performance of a mammography in both years, it was observed that inequities in access to the exam remained similar in both years, showing greater restrictions in carrying out a mammography exam among those aged 65 to 69 years; black in skin color; who lived in the same household with more than three people; with an educational level up to incomplete elementary school or equivalent. By contrast, the lowest socioeconomic income was found in the North region and among those from countryside towns.

Regarding intermediate determinants of health, there has been an improvement in access to mammography exams; however, greater access continues among women who have health insurance. Furthermore, greater restrictions on carrying out the exam continue for women registered with the FHS.

According to variables from the NHS database, the prevalence rates of not having a mammogram decreased from 2013 to 2019; however, the profile of women without access to the exam remained the same during the two years of the NHS, which determines some associated SDH access, such as the structural determinants of inequities in health for black people, the greater number of residents in the household, a lower educational level, a lower income, North and Northeast regions and cities in the countryside; and regarding the intermediate health determinants of the lack of health insurance and registration with the FHS.

Table 2 presents the prevalence ratios according to sociodemographic variables in accordance with the 2013 and 2019 NHS.

As identified in Table 2, the adjusted analysis of data from the 2019/2013 survey conducted by the SDH showed a tendency for vulnerabilities to persist in access to mammography exams in groups of women with lower socioeconomic incomes and low educational levels. Therefore, it was observed that access to a mammography is more restricted for the less privileged sections of the population.

Figure 2 shows the prevalence of failure to undergo a mammography among Brazilian women according to Social Determinants of Health and age groups.

As seen in Figure 2, some SDH were associated with not undergoing mammography ex-

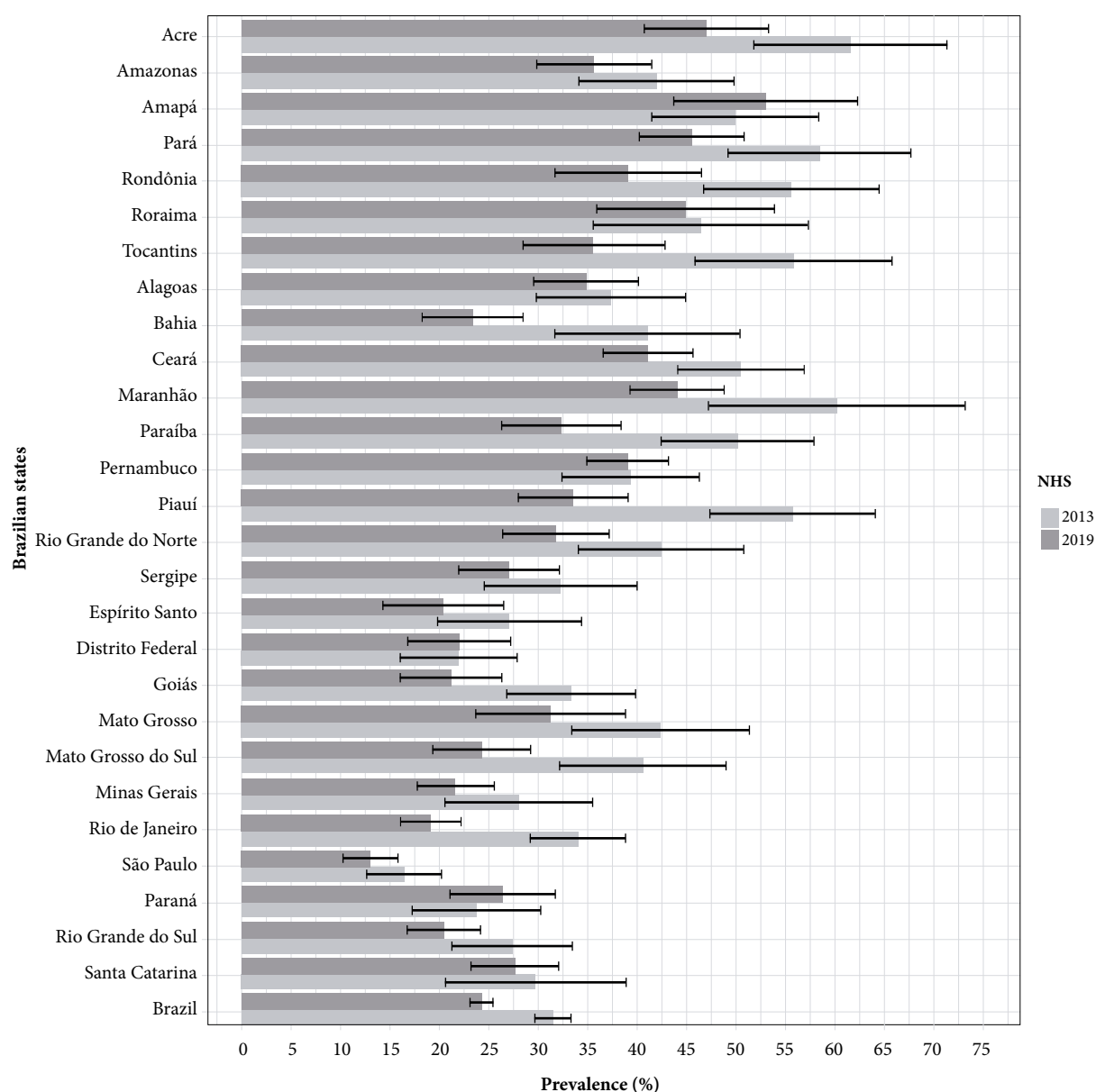


Figure 1. Prevalence of the non-completion of a mammography in Brazilian capitals among women (≥ 50 years of age) interviewed in the 2013 and 2019 NHS in Brazil.

Source: Authors.

ams among Brazilian women. Regarding race, the prevalence of not taking the test decreases over time, but does not reduce the difference between the white and black races, in which the black race still has a higher prevalence of not taking the test, in all age groups. Regarding income, a major discrepancy was found between the 1st and 5th income quintiles. There was an improvement in mammography screening among

women in the 1st income quintile, but this SDH still constitutes an important access factor in all women's age groups.

Regarding the type of city, there was a higher prevalence of the non-performance of a mammography among women in the countryside in the two years evaluated and in all age groups, but with improved access. Regarding educational level, a significant difference was noticed in

Table 1. Comparison of the prevalence of not undergoing a mammography exam according to the Social Determinants of Health of women (≥ 50 years of age) interviewed in the 2013 and 2019 NHS in Brazil.

Variables	2013 (n = 8,539)		2019 (n = 14,795)		p-value
	%	95%CI	%	95%CI	
Total					
Structural Determinants of Health Inequities					
Age range (in years)					0.600
50 to 54	29.6	26.5-32.7	23.3	21.2-25.4	
55 to 59	30.3	27.0-33.5	24.3	22.2-26.4	
60 to 64	32.6	29.2-36.1	24.4	22.3-26.5	
65 to 69	35.5	31.6-39.3	25.5	23.1-28.0	
Color/race					< 0.001
White	25.2	22.8-27.6	20.5	18.9-22.1	
Black	38.3	35.9-40.8	27.8	26.3-29.3	
Residents in household					0.001
One	29.5	26.3-32.8	22.8	20.9-24.8	
Two	28.5	26.1-30.9	22.2	20.6-23.8	
Three or more	33.4	30.9-36.0	25.9	24.1-27.6	
Educational level					< 0.001
Up to incomplete elementary school or equivalent	40.4	38.1-42.8	31.9	30.2-33.6	
Incomplete high school or equivalent	25.2	20.6-29.7	24.6	21.3-27.8	
Incomplete higher education or equivalent	20.5	17.3-23.8	17.3	15.2-19.3	
Complete higher education	14.6	10.2-19.1	10.7	8.8-12.5	
Income quintile					< 0.001
1st Quintile (smallest)	51.3	46.9-55.7	37.3	34.6-40.0	
2nd Quintile	39.0	35.0-43.0	31.4	28.7-34.1	
3rd Quintile	35.4	31.8-39.0	25.8	23.3-28.2	
4th Quintile	21.6	18.5-24.7	19.3	16.7-21.9	
5th Quintile (largest)	12.4	9.6-15.1	10.0	8.5-11.5	
Capitals of the country's macroregion					< 0.001
North	54.5	49.3-59.6	42.2	39.2-45.2	
Northeast	45.4	42.0-48.9	33.8	31.8-35.8	
Midwest	34.3	30.4-38.2	23.9	20.8-26.9	
Southeast	23.1	20.3-25.9	16.7	14.9-18.5	
South	26.6	22.5-30.6	24.3	21.7-26.9	
City of residence					< 0.001
Capital or MR	19.7	17.9-21.4	16.8	15.3-18.2	
Metropolitan region	31.1	27.3-34.9	23.2	20.9-25.5	
Countryside	36.8	34.0-39.6	28.1	26.3-29.8	
Intermediate Determinants of Health					
Have a health plan					< 0.001
Yes	13.4	10.8-15.9	9.7	8.2-11.2	
No	40.0	37.9-42.2	30.1	28.7-31.6	
Household registration with the FHS					< 0.001
Yes	35.9	33.4-38.4	27.4	25.9-28.9	
No	26.0	23.7-28.4	19.1	17.4-20.8	

Notes: 95%CI: 95% confidence interval. MR: Metropolitan Region.

Source: Authors.

terms of not undergoing a mammography performed between the highest strata (complete higher education) and lowest strata (up to in-

complete elementary school), with worse access to mammography exams in women with a lower educational level, in all age groups.

Table 2. Prevalence ratios (PR) by Poisson regression to analyze the crude and adjusted association of the structural determinants of health inequities and the intermediate determinants of health due to the failure to undergo a mammography among Brazilian women (≥ 50 years of age) interviewed in the 2013 and 2019 NHS.

Structural Determinants of Health Inequities	2013 (n = 8,539)				2019 (n = 14,795)				2019/2013			
	Non-performance of mammography				Non-performance of mammography				Non-performance of mammography			
	Gross Analysis		Adjusted Analysis ¹		Gross Analysis		Adjusted Analysis ¹		Gross Analysis		Adjusted Analysis ²	
	RP	95%CI	RP	95%CI	RP	95%CI	RP	95%CI	RP	95%CI	RP	95%CI
Macroregion of the country												
North	--	--	--	--	--	--	--	--	--	--	--	--
Northeast	1.03	0.89-1.18	1.07	0.94-1.22	1.04	0.91-1.18	1.05	0.93-1.19	1.03	0.94-1.13	1.06	0.96-1.16
Midwest	1.10	0.95-1.29	1.16	1.01-1.3	1.05	0.92-1.18	1.08	0.95-1.23	1.06	0.97-1.17	1.12	1.02-1.23
Southeast	1.20	1.03-1.39	1.25	1.08-1.44	1.09	0.96-1.24	1.12	0.99-1.27	1.13	1.02-1.24	1.18	1.07-1.29
South												
City of residence	---	---	---	---	---	---	---	---	---	---	---	---
Capital or MR	1.52	1.36-1.70	1.03	0.91-1.15	1.36	1.24-1.49	0.98	0.88-1.08	1.42	1.32-1.52	1.00	0.93-1.08
Countryside												
Intermediate Determinants of Health	---	---	---	---	---	---	---	---	---	---	---	---
Have a health plan	0.97	0.84-1.10	0.90	0.79-1.02	0.97	0.87-1.09	0.92	0.82-1.02	0.98	0.90-1.07	0.91	0.84-0.99
Yes	1.13	0.99-1.29	0.97	0.84-1.11	1.13	1.02-1.26	0.99	0.88-1.11	1.15	1.06-1.25	0.99	0.90-1.08
No												
Household registration with the FHS	2.76	2.03-3.76	1.21	0.89-1.65	2.99	2.50-3.59	1.44	1.18-1.77	2.97	2.52-3.49	1.34	1.12-1.59
Yes	1.72	1.21-2.43	1.01	0.72-1.42	2.30	1.86-2.85	1.35	1.07-1.70	2.07	1.72-2.51	1.20	0.99-1.45
No	1.40	1.01-1.96	1.00	0.73-1.36	1.62	1.31-1.99	1.12	0.90-1.39	1.54	1.28-1.85	1.06	0.88-1.28
Graduated	---	---	---	---	---	---	---	---	---	---	---	---
Income quintile												
1st Quintile (smallest)	4.14	3.28-5.23	2.11	1.61-2.75	3.72	3.14-4.41	1.70	1.39-2.08	3.93	3.42-4.52	1.87	1.56-2.21
2nd Quintile	3.15	2.46-4.02	1.77	1.35-2.31	3.14	2.64-3.73	1.61	1.32-1.97	3.16	2.73-3.64	1.68	1.42-1.98
3rd Quintile	2.86	2.23-3.66	1.62	1.25-2.10	2.57	2.17-3.06	1.42	1.17-1.74	2.69	2.33-3.11	1.50	1.28-1.76
4th Quintile	1.74	1.35-2.25	1.27	0.97-1.66	1.92	1.57-2.36	1.32	1.07-1.63	1.85	1.58-2.18	1.29	1.09-1.53
5th Quintile	---	---	---	---	---	---	---	---	---	---	---	---

it continues

Regarding the structural determinants of health, there was an improvement in the rates of access of women without health insurance to mammography exams in all age groups, however, the discrepancy between women with and without health insurance still continues. Figure 2 also highlights the difference in access to mammography exams in all age groups when comparing women without and with registration in the FHS, with lower access among the latter.

Discussion

Data presented in this study show substantial differences in the comparison between the years 2013 and 2019 regarding the non-performance of mammography exams, with an improvement in the national scenario and greater access. In all states, a higher prevalence of mammography exams was observed, with peculiarities related to health determinants.

Table 2. Prevalence ratios (PR) by Poisson regression to analyze the crude and adjusted association of the structural determinants of health inequities and the intermediate determinants of health due to the failure to undergo a mammography among Brazilian women (≥ 50 years of age) interviewed in the 2013 and 2019 NHS.

Structural Determinants of Health Inequities	2013 (n = 8,539)				2019 (n = 14,795)				2019/2013			
	Non-performance of mammography				Non-performance of mammography				Non-performance of mammography			
	Gross Analysis		Adjusted Analysis ¹		Gross Analysis		Adjusted Analysis ¹		Gross Analysis		Adjusted Analysis ²	
	RP	95%CI	RP	95%CI	RP	95%CI	RP	95%CI	RP	95%CI	RP	95%CI
Macroregion of the country												
North	---	---	---	---	---	---	---	---	---	---	---	---
Northeast	0.83	0.74-0.94	0.82	0.73-0.91	0.80	0.73-0.88	0.77	0.70-0.84	0.82	0.76-0.88	0.79	0.73-0.85
Midwest	0.63	0.54-0.73	0.81	0.71-0.93	0.57	0.49-0.65	0.67	0.58-0.78	0.60	0.54-0.67	0.73	0.66-0.81
Southeast	0.43	0.36-0.50	0.57	0.48-0.66	0.40	0.35-0.45	0.49	0.43-0.56	0.41	0.37-0.46	0.53	0.48-0.58
South	0.49	0.41-0.58	0.60	0.51-0.72	0.58	0.51-0.66	0.66	0.57-0.77	0.54	0.49-0.60	0.64	0.57-0.71
City of residence												
Capital or MR	---	---	---	---	---	---	---	---	---	---	---	---
Countryside	1.52	1.36-1.69	1.29	1.16-1.43	1.45	1.2-1.59	1.19	1.08-1.31	1.48	1.38-1.59	1.23	1.15-1.32
Intermediate Determinants of Health												
Have a health plan												
Yes	---	---	---	---	---	---	---	---	---	---	---	---
No	2.99	2.46-3.65	1.98	1.58-2.49	3.11	2.64-3.65	1.94	1.62-2.33	3.02	2.66-3.42	1.96	1.70-2.26
Household registration with the FHS												
Yes	---	---	---	---	---	---	---	---	---	---	---	---
No	0.73	0.65-0.81	1.05	0.94-1.16	0.70	0.62-0.78	0.99	0.88-1.10	0.73	0.67-0.78	1.01	0.94-1.09

Notes: 1 - Adjustment for the variables of age group, color/race, number of residents in the household, educational level, household income level per capita, has of a health plan, and household registration with the FHS; 2 - Adjustment for the variables of age group, color/race, number of residents in the household, educational level, household income level per capita, has of a health plan, household registration with the FHS, and year of NHS.

Source: Authors.

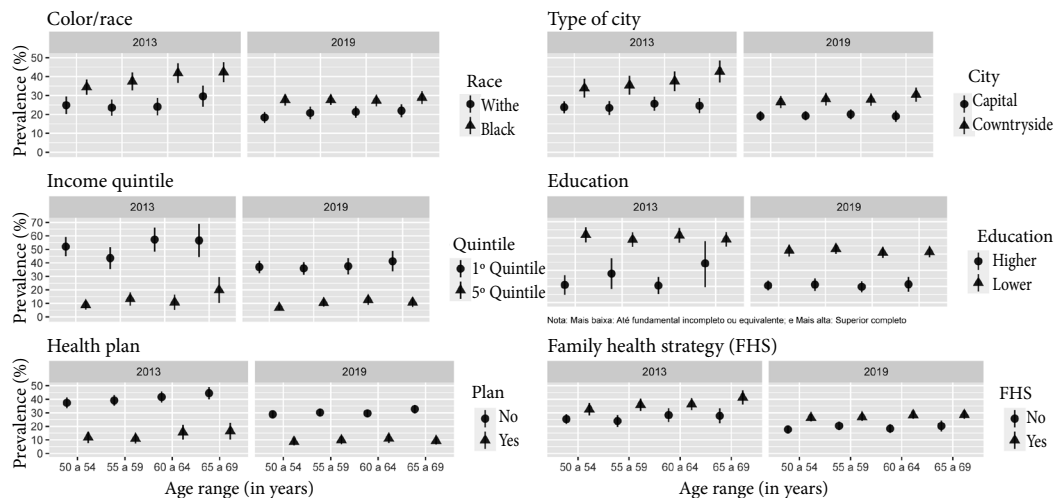


Figure 2. Prevalence of not having a mammogram among Brazilian women by age group. 2013 and 2019 NHS. Brazil, 2023.

Source: Authors.

Regarding the Structural Determinants of Health Inequities, the influence of age, number of residents in the household, educational level, income, region of the country, and city of residence was observed.

In the period evaluated, in both years in the age group of women over 60 years old, it was prevalent that mammography exams were not carried out, which corroborates international studies¹⁷. This result is alarming, given the importance of age as a risk factor for the development of breast cancer. Although many organizations agree to start mammography screening at age 50 (source), there is no clear consensus on the age to stop screening¹⁸.

The incidence of breast cancer increases with age up to 80 years. Mammography screening has demonstrated effectiveness in reducing breast cancer mortality among women between 50 and 74 years of age¹⁹. Furthermore, it is useful in reducing breast cancer mortality by detecting small cancers in their early stages. Higher rates of detection of invasive cancer in older women are secondary to the decrease in breast density with age, a result of the greater sensitivity and specificity of the exam²⁰.

Women who lived in houses with the largest number of residents (two) were more likely to undergo mammography exams. This fact can be explained by the established social support. Social support from friends and family plays a key role in mammography screening. Through this, it is possible to induce self-efficacy in people and overcome financial and psychological barriers, since the search for health also has a social nature, which means that a person is more likely to undergo a mammogram when he/she feels that it is important to his/her family, and the person is supported by his/her family²¹.

Regarding educational level, a lower level was associated with a higher prevalence of not having a mammogram. Studies show that women with higher educational levels have fewer perceived barriers to taking the exam and illustrate that women are more likely to make better decisions regarding issues related to their health and have a greater understanding of the disease process^{22,23}. Educational level is associated with health literacy and this, when low, is a known barrier to health decisions²⁴. Furthermore, women with a lower level of education are more likely to be diagnosed at an advanced stage²⁵.

In this sense, there is a need to develop intervention strategies focusing on education programs that work on knowledge and treat limiting health beliefs, which enable a reduction

in fear and an improvement in knowledge for a better understanding of early breast cancer screening and prevention²⁶.

Regarding income, higher incomes increased access to mammography exams. One study, using institutional data from two American College of Surgeons breast centers compared an inner-city hospital that served socioeconomically marginalized communities and a second regional center in a suburban county that served less socioeconomically disadvantaged communities. That study found that women in low-income quartiles experienced longer completion times for each stage of breast cancer screening. The lack of transportation was the most significant barrier to timely screening²⁷.

There are also social and financial barriers related to income among women undergoing mammography screening. Research carried out with mammography records in the United States between 2012 and 2017 of 393,430 women, aged 40 years or older, showed that barriers were less likely in women with a higher median family income²⁸.

The analysis of the country's macro-region highlights disparities, with the North region presenting the worst indicators. Furthermore, there was greater access to mammography exams over the years, with the Southeast region showing a higher prevalence of access, along with the South region. In the period between 2013 and 2019, the states of Acre and Pará showed high rates of non-performance of mammography exams. As part of the North region, these states stand out because, although they have achieved a reduction in the number of people not undergoing exams during the evaluated period, they still have unsatisfactory data on breast cancer screening.

An ecological study carried out with data from INCA in Brazil from 2010 to 2018 presents results that point to the state of Pará as responsible for 45% of all breast cancer cases, with half of these cases associated with the capital Belém. This fact may be related to a lack of specialist medical professionals, as well as the scarcity of mammograms in the region and the inefficiency of actions carried out by primary care due to the low number of professionals able to meet the health demands of the population²⁹.

To develop effective screening, in addition to offering mammography exams, qualified professionals are needed, both to carry out the exam and to interpret and guide women after the result. A high social inequality and a low rate of mammography exams was observed in

the majority of the North region and some municipalities in the Northeast region, which is the opposite result of that found in the Southeast and South regions. The rate of mammography exams is influenced by the Gini Index and HDI, variables that are also related to socioeconomic factors, because when these are crossed, the greater the inequality, the lower the access to breast cancer screening, and the higher the HDI, the greater the number of mammograms³⁰.

In this study, residents of countryside towns had a higher prevalence of not having a mammogram compared to women in the capital or MR. Several studies confirm the aforementioned findings, as the presence of a mammography facility close to a woman's residence increases the chances of screening^{27,31}.

Among the factors listed, situations that prevent women from being taken to the facilities to undergo the exam may be related to later stages of breast cancer at the time of diagnosis, which would be associated with worse survival, and the tendency to reduce the use of mammography exams over time³¹.

The National Health Survey conducted in the US showed that, although the majority of women reported no payment for their most recent mammography screening in 2015, some payment was reported by > 20% of women aged 50 to 64 years or aged 65 to 74 years of age with Medicare only, and for almost 40% of uninsured

women, aged 50 to 64 years. The need for payment can constitute a barrier to accessing adequate screening³².

Primary care plays a key role in ensuring comprehensive care through the family health strategy, promoting breast cancer screening actions in vulnerable populations without access to health plans. It is evident that the teams are aligned in carrying out an active search for the target population, contributing to the effectiveness of actions carried out in breast cancer control program²³, thus increasing the demand for the exam.

Final considerations

The present study analyzed the Structural Determinants of Health Inequities and the Intermediate Determinants of Health that could contribute to the identification of factors for not undergoing mammography exams among Brazilian women. It was observed that structural factors, such as economic income, color, education level, and age group are harmful and interfere with annual mammograms. The findings indicate the need for differentiated approaches to health promotion and education for women in view of the benefits of routine mammography screening for breast cancer screening purposes.

Collaborations

Conception, design, analysis, interpretation of data and relevant critical review of intellectual content: DM Silva, YA Cavalcante, BLCA Oliveira, AKB Pinheiro, PS Aquino. Interpretation and writing of the work, final approval of the version to be published and responsibility for all aspects of the manuscript: DM Silva, YA Cavalcante, MVO Lopes, AFC Fernandes, BLCA Oliveira, AKB Pinheiro, PS Aquino.

Acknowledgements

Oliveira BLCA and Silva DM are CAPES/BRAZIL scholarship holders and wish to thank their support for this research. We also wish to thank the federal universities of Maranhão (UFMA) and Ceará (UFC), and the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brazil (CAPES) – Financing Code 001, to the UFMA Postgraduate Program in Nursing.

References

1. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin* 2018; 68(6):394-424.
2. Organização Mundial de Saúde (OMS). Câncer de mama [Internet]. 2020. [acessado 2023 jul 5]. Disponível em: <http://www.who.int/cancer/prevention/diagnosis-screening/breast-cancer/en/>
3. Instituto Nacional do Câncer (INCA). Estimativa 2020: incidência do câncer no Brasil [Internet]. 2020. [acessado 2023 jul 5]. Disponível em: <https://www.inca.gov.br/sites/ufu.sti.inca.local/files//media/document//estimativa-2020-incidencia-de-cancer-no-brasil.pdf>
4. Albright FS, Kohlmann W, Neumayer L, Buys SS, Matsen CB, Kaphingst KA, Cannon-Albright LA. Population-based relative risks for specific family history constellations of breast cancer. *Cancer Causes Control* 2019; 30(6):581-590.
5. Giannakeas V, Narod SA. The incidence of fatal breast cancer measures the increased effectiveness of therapy in women participating in mammography screening. *Cancer* 2019; 125(12):2130.
6. Grimm LJ, Avery CS, Hendrick E, Baker JA. Benefits and Risks of Mammography Screening in Women Ages 40 to 49 Years. *J Prim Care Community Health*. 2022; 13:21501327211058322.
7. Silva RP, Gigante DP, Amorim MHC, Leite FMC. Fatores associados à realização de mamografia em usuárias da atenção primária à saúde em Vitória, Espírito Santo. *Epidemiol Serv Saude* 2019; 28(1):e2018048.
8. World Organization of Health (WHO). Social Determinants of Health [Internet]. 2023. [cited 2023 jul 5]. Available from: https://www.who.int/health-topics/social-determinants-of-health#tab=tab_1
9. Ponce-Chazarri L, Ponce-Blandón JA, Immordino P, Giordano A, Morales F. Barriers to Breast Cancer-Screening Adherence in Vulnerable Populations. *Cancers (Basel)* 2023; 15(3):604.
10. Ramos ACV, Alves LS, Berra TZ, Popolin MP, Arcoverde MAM, Campoy LT, Martoreli JF, Lapão LV, Palha PF, Arcêncio RA. Estratégia Saúde da Família, saúde suplementar e desigualdade no acesso à mamografia no Brasil. *Rev Panam Salud Publica* 2018; 42:e166.
11. Ivanova A, Kvaem IL. Psychological predictors of intention and avoidance of attending organized mammography screening in Norway: applying the Extended Parallel Process Model. *BMC Womens Health* 2021; 21(1):67.
12. Souza-Júnior PRB, Freitas MPS, Antonaci GA, Szwarcwald CL. Desenho da amostra da Pesquisa Nacional de Saúde 2013. *Epidemiol Serv Saude* 2015; 24(2):207-216.
13. Stopa SR, Szwarcwald CL, Oliveira MM, Gouvea ECDP, Vieira MLFP, Freitas MPS, Sardinha LMV, Macário EM. Pesquisa Nacional de Saúde 2019: histórico, métodos e perspectivas. *Epidemiol Serv Saude* 2020; 29(5):e2020315.

14. Instituto Brasileiro de Geografia e Estatística (IBGE). Pesquisa Nacional de Saúde 2019: informações sobre domicílios, acesso e utilização dos serviços de saúde. Rio de Janeiro: IBGE; 2020.
15. Solar O, Irwin A. *A conceptual framework for action on the social determinants of health*. Geneva: WHO; 2010.
16. Instituto Nacional de Câncer (INCA). *Diretrizes para a detecção precoce do câncer de mama no Brasil*. Rio de Janeiro: INCA; 2015.
17. Al-Wassia RK, Farsi NJ, Merdad LA, Hagi SK. Patterns, knowledge, and barriers of mammography use among women in Saudi Arabia. *Saudi Med J* 2017; 38(9):913-921.
18. Mack DS, Lapane KL. Screening Mammography Among Older Women: A Review of United States Guidelines and Potential Harms. *J Womens Health (Larchmt)* 2019; 28(6):820-826.
19. Schrager S, Ovsepyan V, Burnside E. Breast Cancer screening in older women: the importance of shared decision making. *J Am Board Fam Med* 2020; 33(3):473-480.
20. Lee CS, Moy L, Joe BN, Sickles EA, Niell BL. Screening for breast cancer in women age 75 years and older. *Am J Roentgenol* 2018; 210(2):256-263.
21. Momenimovahed Z, Tiznobaik A, Taheri S, Hassani-pour S, Salehiniya H. A review of barriers and facilitators to mammography in Asian women. *Ecan-cermedicalscience* 2020; 14:1146.
22. Orji CC, Kanu C, Adelodun AI, Brown CM. Factors that Influence Mammography Use for Breast Cancer Screening among African American Women. *J Natl Med Assoc* 2020; 112(6):578-592.
23. Oliveira RDP, Ferreira IS, Castro RCMB, Fernandes AFC. Association between sociodemographic characteristics and adherence to early detection of breast cancer. *Rev Rene* 2022; 23:e71920.
24. Jansen T, Rademakers J, Waverijn G, Verheij R, Osborne R, Heijmans M. The role of health literacy in explaining the association between educational attainment and the use of out-of-hours primary care services in chronically ill people: a survey study. *BMC Health Serv Res* 2018;18(1):394.
25. Almeida RJ, Luizaga CTM, Eluf-Neto J, Nunes HRC, Pessoa EC, Murta-Nascimento C. Impact of educational level and travel burden on breast cancer stage at diagnosis in the state of Sao Paulo, Brazil. *Sci Rep* 2022; 12(1):8357.
26. Sousa TP, Guimarães JV, Vieira F, Salge AKM, Costa NM. Fatores envolvidos na não realização dos exames de rastreamento para o câncer de mama. *Rev Eletr Enferm* 2019; 21:53508.
27. Castaldi M, Smiley A, Kechejian K, Butler J, Latifi R. Disparate access to breast cancer screening and treatment. *BMC Womens Health* 2022; 22(1):249.
28. Henderson LM, O'Meara ES, Haas JS, Lee CI, Kerlikowske K, Sprague BL, Alford-Teaster J, Onega T. The Role of Social Determinants of Health in Self-Reported Access to Health Care Among Women Undergoing Screening Mammography. *J Womens Health (Larchmt)* 2020; 29(11):1437-1446.
29. Silva KA, Marques-Júnior JWP, Souza LPM, Santos PHP, Lima PDL, Beltrão-Lima S, Rodrigues-An-tunes S, Feio DCA. Breast cancer: Analysis of the mortality trend in women in the State of Pará-Brazil. *RSD* 2021; 10(13):e109101320929.
30. Bezerra HS, Melo TFV, Barbosa JV, Feitosa EELC, Sousa LCM. Avaliação do acesso em mamografias no Brasil e indicadores socioeconômicos: um estudo espacial. *Rev Gaucha Enferm* 2018; 39:e20180014.
31. Jewett PI, Gangnon RE, Elkin E, Hampton JM, Jacobs EA, Malecki K, LaGro J, Newcomb PA, Tren-tham-Dietz A. Geographic access to mammography facilities and frequency of mammography screening. *Ann Epidemiol* 2018; 28(2):65-71.e2.
32. Sabatino SA, Thompson TD, Miller JW, Breen N, White MC, Breslau E, Shoemaker ML. Prevalence of out-of-pocket payments for mammography screening among recently screened women. *J Womens Health (Larchmt)* 2019; 28(7):910-918.

Article submitted 18/07/2023

Approved 03/10/2023

Final version submitted 05/10/2023

Chief editors: Maria Cecília de Souza Minayo, Romeu Gomes, Antônio Augusto Moura da Silva