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Scope of the Policy for Early Detection of Breast Cancer in Brazil: A Cross-Sectional Study

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Abstract

This study discusses the challenges encountered in breast cancer screening coverage in Brazil. The aim was to verify mammography coverage in Brazil. A cross-sectional study was carried out using data provided by the Ministry of Health verifying the following information: method of detection, analysis of coverage, clinical and sociodemographic variables of breast cancer. We observed significant differences in the number of mammograms performed between Brazilian regions and between levels of education, which may be determining factors for adherence to the examination, as well as differences related to the collection period analyzed. Raising awareness among the population about the importance of mammography and training health professionals are fundamental to increasing coverage. It is necessary to invest in awareness-raising strategies and in a health care network prepared to welcome women with suspicious signs and symptoms, ensuring investigation and treatment.

Keywords: breast cancer; screening; mammography; early diagnosis; breast cancer coverage

1. Introduction

Breast cancer is a major global public health concern that extends beyond women's health, imposing substantial social and economic burdens. In Brazil, it is the most commonly diagnosed malignancy among women, excluding non-melanoma skin cancers, with approximately 74,000 new cases projected between 2023 and 2025, corresponding to an incidence rate of 66.5 cases per 100,000 women [1].

Breast carcinogenesis arises from the uncontrolled proliferation of mammary epithelial cells, predominantly affecting women, although a small proportion of cases also occur in men [2]. Breast morphology and physiology are dynamically influenced throughout a woman's lifetime by hormonal regulation and other biological determinants [3,4].

Well-established risk factors include increasing age, genetic susceptibility, reproductive history, hormonal influences, and behavioral or environmental exposures. Specific conditions such as early menarche (<12 years), late menopause (>55 years), nulliparity, first full-term pregnancy after age 30, prolonged use of combined oral contraceptives,

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postmenopausal hormone replacement therapy, and pathogenic variants in the BRCA1 and BRCA2 genes are strongly associated with higher risk [1,5]. Moreover, modifiable factors—alcohol consumption, smoking, physical inactivity, obesity, and occupational or environmental exposures (e.g., ionizing radiation, pesticides, benzene, persistent organic pollutants)—further contribute to disease susceptibility.

Clinical presentation is variable, but timely recognition is critical for favorable outcomes. Alarming findings include breast nodules persisting beyond a menstrual cycle, firm or fixed lesions with progressive growth, abnormal nipple discharge, refractory eczematous skin lesions, axillary lymphadenopathy, breast enlargement with peau d'orange changes, nipple retraction, and distortion of breast contour. Early detection of these signs by patients and healthcare professionals is pivotal for prompt diagnosis and intervention [1,5,6].

Breast cancer comprises a heterogeneous spectrum of histological and molecular subtypes. Classification considers histopathological type, tumor grade, clinical stage, hormone receptor expression (estrogen and progesterone), and HER2 status, underscoring the importance of molecular phenotyping to guide individualized treatment strategies [7,8]. Among non-invasive lesions, ductal carcinoma in situ (DCIS) is the most prevalent. Although confined to the ductal system without basement membrane invasion, 14–16% of DCIS cases progress to invasive carcinoma within 10 years. Ultimately, invasive ductal carcinoma accounts for nearly 75% of breast cancer diagnoses [9].

In Brazil, the National Guidelines for Early Detection of Breast Cancer emphasize reducing modifiable risk exposures, lowering mortality, and improving quality of life for affected women. The strategy is grounded in three complementary pillars: (i) population awareness of early warning signs, (ii) professional training for accurate case evaluation, and (iii) health system preparedness to ensure timely diagnostic confirmation and comprehensive, continuous care [10].

Although biennial mammography for women aged 50 to 69 years constitutes the cornerstone of national screening policies, grounded in scientific evidence and aligned with international recommendations [11,12], significant disparities in coverage and access persist, reflecting regional and socioeconomic inequalities in a country of continental dimensions [13,14].

These gaps highlight the urgent need for a critical assessment of adherence and equity in screening implementation, as they directly influence the effectiveness of public policies, early detection, and breast cancer mortality reduction. In this context, the present study aims to analyze mammographic coverage in Brazil over the past decade and to identify the socioeconomic and structural factors that determine participation in screening programs, thereby providing evidence to strengthen public health strategies for breast cancer control.

2. Methods

A cross-sectional study was conducted using secondary data from the Brazilian Ministry of Health to assess detection methods, screening coverage, and clinical and sociodemographic characteristics associated with breast cancer.

Epidemiological and morbidity data were obtained from the Cervical and Breast Cancer Information System (SISCAN), while demographic and socioeconomic data (by state, region, and year) were collected from the Resident Population Estimates by Municipality, Age, and Sex (2000–2021) compiled by the Brazilian Institute of Geography and Statistics (IBGE). All data were accessed through the DATASUS/TABNET platform (https://datasus.saude.gov.br/informacoes-de-saude-tabnet/) (accessed on 10 September 2025).

All datasets are publicly available, fully anonymized, and contain no personally identifiable information; therefore, ethical approval and informed consent were not required.

From SISCAN, clinical and sociodemographic variables describing the number of breast examinations were extracted by municipality, year, age group, education, sex, high-risk status, nodule requirement, clinical indication, mammography type (screening or diagnostic), BI-RADS category, and reporting year. Data were cross-referenced with IBGE population information, aligning with the "competence year" (billing year). The analysis period covered 2013–2022.

Figure 1 depicts the workflow for data acquisition, variable extraction, and integration of SISCAN and IBGE databases, followed by statistical analyses and the organization of results.

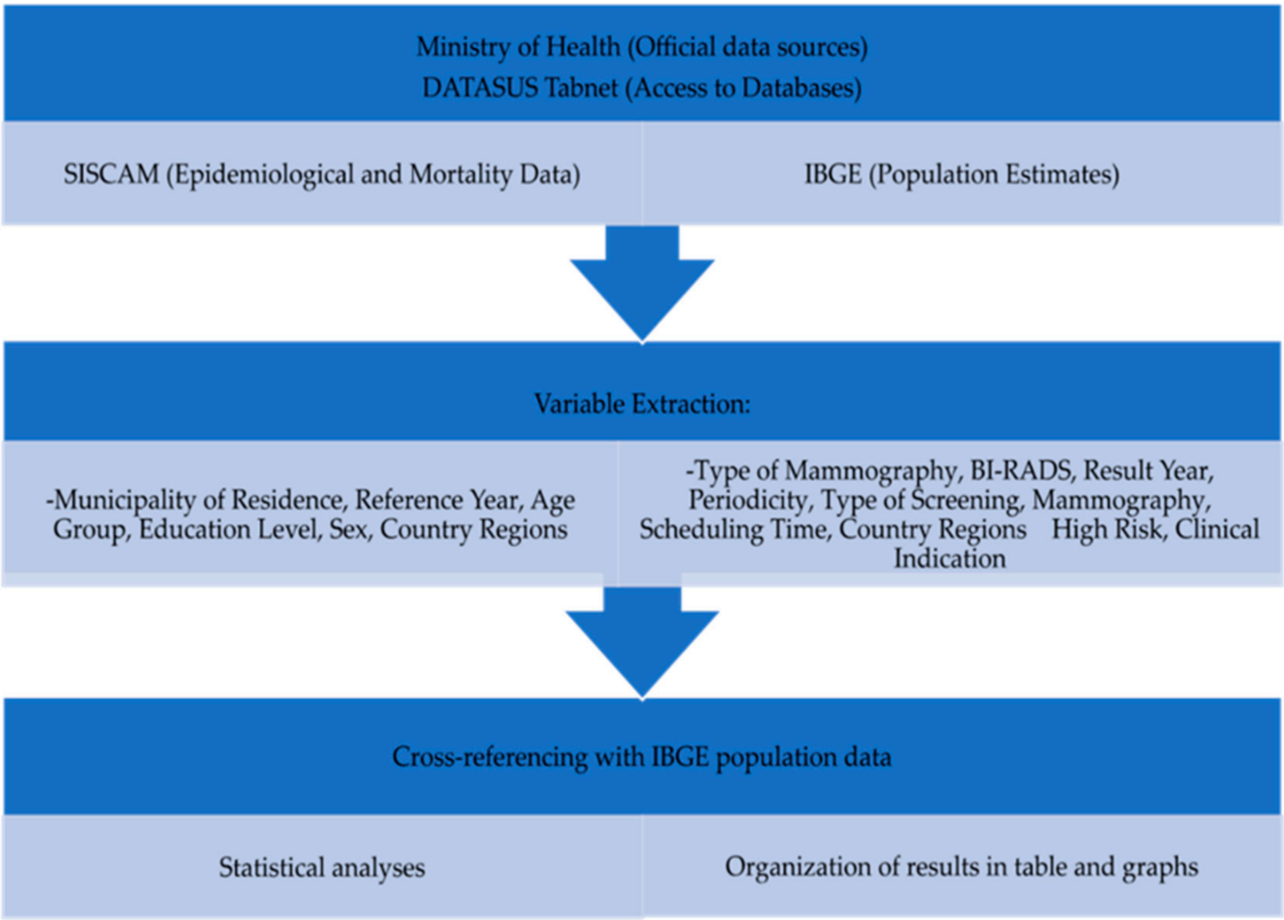

Figure 1. Flowchart of data and cross-tabulation.

Table 1 presents the descriptive analysis of the clinical and sociodemographic variables of women who underwent mammography in Brazil between 2013 and 2022. Data were organized by sex, education level, age group, high-risk classification (family history of breast cancer), mammography periodicity, exam type (screening or diagnostic), BI-RADS category, exam scheduling, and breast laterality. Each variable was extracted from SISCAN and cross-tabulated with IBGE data to generate a comprehensive national dataset representing the distribution of mammography procedures across demographic segments.

Table 1. Description of the number of breast exams according to clinical and sociodemographic variables in Brazil (2013–2022).

Variables	Years									
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
	N									
Sex										
Male	255	4752	4558	4565	5108	4916	5173	3455	4627	7653
Female	92,972	1,796,222	2,047,504	2,203,727	2,636,176	2,807,228	3,063,618	1,864,892	2,675,920	3,293,403
Education										
Illiterate	866	6373	1888	38	24	17	8	0	0	0
Incomplete elementary school	6673	40,759	13,491	277	197	121	66	4	0	1
Complete Elementary School	3604	18,997	8215	100	79	73	74	0	0	0
Complete high school	4688	18,182	5977	105	83	86	77	2	0	0
Complete Higher Education	650	3922	1349	14	16	20	15	0	0	0
Age group										
Up to 9 years	31	303	509	473	515	486	581	317	376	484
Between 10 and 14 years old	11	146	155	141	139	159	184	145	119	174
Between 15 and 19 years old	77	829	966	823	922	927	1066	572	635	766
Between 20 and 24 years old	156	1639	2095	2083	2339	2392	2769	1480	1838	2218
Between 25 and 29 years old	331	3539	4258	4072	4498	4613	5415	3168	3868	5041
Between 30 and 34 years old	891	9577	11,931	11,887	13,046	12,978	15,394	8756	10,432	13,095
Between 35 and 39 years old	4648	64,991	67,972	66,536	70,429	70,628	71,041	41,868	52,045	59,228
Between 40 and 44 years old	15,384	259,080	287,605	285,109	303,504	332,977	368,743	226,717	328,726	394,121
Between 45 and 49 years old	17,449	309,358	352,270	357,014	390,308	423,306	462,523	288,666	415,163	494,391
Between 50 and 54 years old	17,177	369,835	420,284	467,056	581,183	603,232	646,093	392,185	559,829	664,199
Between 55 and 59 years old	14,414	303,060	346,820	391,025	492,748	518,664	569,158	347,921	507,208	627,493
Between 60 and 64 years old	10,505	231,312	265,011	299,471	383,970	413,381	452,371	273,077	397,343	511,755
Between 65 and 69 years old	6607	143,873	169,042	193,923	252,445	270,335	298,943	179,091	258,457	338,379
Between 70 and 74 years old	3329	63,048	74,778	78,807	90,146	99,451	110,307	66,873	94,593	124,925
Between 75 and 79 years old	1561	28,213	34,153	35,180	38,829	41,577	45,315	26,493	35,556	46,799
Over 79 years old	658	12,175	14,221	14,712	16,278	17,049	18,889	11,018	14,198	17,847

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Table 1. *Cont.*

Variables	Years									
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
	N									
High risk										
Yes	15,937	246,247	297,808	332,623	399,061	431,530	495,680	318,279	437,298	515,947
No	63,624	1,284,343	1,465,290	1,589,690	1,894,334	2,006,497	2,159,243	1,269,937	1,821,438	2,269,237
Do Not Know	13,328	264,304	283,019	279,065	340,892	368,735	408,434	276,566	418,268	515,841
Periodicity										
same Year,	3033	46,181	68,596	75,896	79,914	122,907	109,485	61,294	82,019	90,454
1 year	29,600	476,839	642,572	763,877	853,279	873,958	951,263	587,625	561,528	753,443
2 years	15,490	335,629	373,396	463,652	617,198	640,084	699,647	427,547	715,245	585,232
3 years	6523	108,130	123,858	123,601	215,099	260,597	272,340	168,740	320,283	445,699
4 years or more	5305	121,955	117,452	112,121	135,404	198,016	290,722	198,654	380,637	604,861
Type of mammogram requested										
Diagnosed Mamog,	1925	35,404	47,553	49,736	64,509	68,532	79,413	52,370	60,707	64,652
Screening Mamog.	91,304	1,765,593	2,004,530	2,158,587	2,576,798	2,743,626	2,989,391	1,815,982	2,619,847	3,236,429
Type of screening mammogram										
Target population	83,301	1,672,581	1,886,127	2,028,314	2,417,107	2,569,821	2,791,553	1,681,111	2,431,962	3,013,259
High-risk population (family history)	7221	73,426	91,918	98,747	119,816	128,165	146,401	89,286	132,132	166,471
Patient previously treated for breast cancer	782	19,586	26,479	31,520	39,873	45,637	51,433	45,585	55,753	56,700
BI-RADS										
Category 0	9913	197,109	225,532	244,907	290,192	313,286	341,455	226,566	330,458	392,619
Category 1	41,444	753,073	837,418	871,514	1,006,445	1,029,344	1,080,411	615,442	869,814	1,028,152
Category 2	38,803	796,727	921,741	1,018,127	1,255,846	1,376,333	1,544,306	957,142	1,393,040	1,779,458
Category 3	2186	40,131	50,530	56,294	67,687	67,678	72,137	46,771	57,180	63,784
Category 4	749	11,306	13,613	14,112	17,107	20,788	24,455	17,440	23,311	28,961
Category 5	99	2091	2581	2661	3176	3658	4341	3295	4560	5286
Category 6	11	560	666	708	854	1071	1699	1696	2190	2820
MammographSchedul										
Up to 30 days	41,713	855,612	941,366	1,015,712	1,288,341	1,319,891	1,412,994	944,581	1,428,676	1,575,434
31–60 days	31,552	489,943	559,894	575,705	695,701	707,647	785,256	410,108	617,902	772,189
more than 60	19,964	455,442	550,823	616,906	657,265	784,620	870,554	513,663	633,976	953,458

Table 1. *Cont.*

Variables	Years									
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
	N									
Mammography request										
Yes, right breast	2902	54,051	65,293	70,758	82,838	89,431	103,607	70,975	93,031	41,994
Yes, left breast	2640	58,666	70,075	76,562	89,998	97,231	112,283	76,727	101,755	45,254
Yes, both	1289	25,561	31,231	35,138	43,429	48,396	56,391	38,313	52,578	23,691
No	86,398	1,662,719	1,885,484	2,025,865	2,425,042	2,577,100	2,796,523	1,682,337	2,433,190	1,163,007

Footnote: Age groups below 20 years (≤9, 10–14, and 15–19 years) appear in the dataset because they are part of the official SISCAN database from the Brazilian Ministry of Health. These cases likely result from data-entry or classification errors and were retained only for methodological transparency. Their inclusion does not imply that mammography screening is recommended for these age groups.

Table 2 relates the number of mammograms to educational level, filtered for 2013–2022. Education was fixed in the columns, and sex, age group, high-risk status, screening periodicity, exam type, BI-RADS category, and other parameters were arranged in rows.

Table 2. Description of the number of breast exams according to schooling in Brazil (2013–2022).

Variables	Education				
	Illiterate	Incomplete Elementary School	Complete Elementary School	Complete High School	Complete Higher Education
	N				
Sex					
Male	36	208	114	107	13
Female	9178	61,378	31,027	29,093	5973
Age group					
Up to 9 years	1	12	6	9	0
Between 10 and 14 years old	0	4	7	6	1
Between 15 and 19 years old	7	24	41	48	4
Between 20 and 24 years old	4	40	75	103	17
Between 25 and 29 years old	7	85	154	243	43
Between 30 and 34 years old	16	256	380	555	92
Between 35 and 39 years old	90	1523	1476	2045	465
Between 40 and 44 years old	419	6630	5325	6036	1236
Between 45 and 49 years old	633	8549	5703	5927	1240
Between 50 and 54 years old	1142	11,202	6182	5405	1238
Between 55 and 59 years old	1309	10,595	4504	3786	749
Between 60 and 64 years old	1742	8957	3305	2422	491

Table 2. *Cont.*

Variables	Education				
	Illiterate	Incomplete Elementary School	Complete Elementary School	Complete High School	Complete Higher Education
	N				
Between 65 and 69 years old	1832	7342	2159	1401	266
Between 70 and 74 years old	1025	3744	1035	715	83
Between 75 and 79 years old	620	1829	558	338	36
Over 79 years old	367	794	231	160	25
High risk (family history)					
Yes	940	8516	6028	7084	1259
No	7089	47,042	22,354	20,069	4281
Do Not Know	1150	5823	2638	1940	432
Periodicity					
Same year,	173	1329	701	727	142
1 year	1702	14,994	7724	7568	1635
2 years	1415	12,554	7402	6079	1240
3 years	635	5138	2381	2257	490
4 years or more	926	6289	2650	2730	611
Type of mammogram requested					
Diagnostic mamog.	139	1276	968	1059	207
Screening mamog.	9075	60,313	30,174	28,141	5779
Type of screening mammogram					
Target population	8706	56,693	26,831	23,631	5197
High-risk population (family history)	281	2989	3086	4298	513
Patient previously treated for breast cancer	87	631	257	212	69
BI-RADS					
Category 0	809	5860	3004	2784	686
Category 1	2643	22,754	14,155	13,684	2579
Category 2	5498	31,188	13,070	11,948	2546
Category 3	183	1261	646	548	129
Category 4	59	399	211	191	39
Category 5	20	107	48	36	6
Category 6	2	16	6	8	1

Table 2. *Cont.*

Variables	Education				
	Illiterate	Incomplete Elementary School	Complete Elementary School	Complete High School	Complete Higher Education
	N				
Mammography Schedule					
Up to 30 days	4290	24,779	14,242	15,606	2803
31–60 days	2341	16,867	7594	6079	1474
more than 60	2583	19,943	9306	7515	1709
Mammography request					
Yes, right breast	226	1977	1173	1091	225
Yes, left breast	244	2158	1272	1179	296
Yes, both	96	819	478	655	147
No	8648	56,634	28,219	26,275	5318

Table 3 compiles regional data from IBGE population statistics (2013–2022), considering only the female population. Variables such as age group, high-risk status, periodicity, exam type, BI-RADS category, scheduling, and breast side were cross-referenced and aggregated into a unified database.

Table 3. Description of the number of breast exams according to schooling in Brazil (2013–2022).

Variables	Regions				
	North	Northeast	Southeast	South	Midwestern
	N				
Sex					
Male	1920	13,728	16,005	10,003	3406
Female	759,711	6,369,591	8,209,364	5,702,005	1,440,984
Age group					
Up to 9 years	131	868	1572	883	333
Between 10 and 14 years old	49	395	447	282	90
Between 15 and 19 years old	278	1173	2201	2942	529
Between 20 and 24 years old	665	2587	5457	7675	1283
Between 25 and 29 years old	1302	5272	11,426	14,879	2725
Between 30 and 34 years old	3886	17,177	34,151	36,755	7894
Between 35 and 39 years old	19,467	132,725	182,824	162,402	35,589
Between 40 and 44 years old	106,671	753,000	871,554	628,738	199,452
Between 45 and 49 years old	131,997	931,469	1,078,952	822,087	243,096
Between 50 and 54 years old	138,502	1,292,539	1,558,480	1,059,896	263,935
Between 55 and 59 years old	110,165	1,056,316	1,405,926	942,683	218,373

Table 3. *Cont.*

Variables	Regions				
	North	Northeast	Southeast	South	Midwestern
	N				
Between 60 and 64 years old	80,807	795,387	1,136,013	749,798	161,466
Between 65 and 69 years old	47,397	525,556	740,362	492,427	97,435
Between 70 and 74 years old	18,827	181,283	269,937	218,975	40,816
Between 75 and 79 years old	7659	75,575	116,136	88,405	16,852
Over 79 years old	3212	31,371	52,008	32,931	6642
High risk (family history)					
Yes	80,354	661,933	1,097,908	1,146,898	189,158
No	485,226	4,001,189	5,473,250	3,544,359	926,856
Do Not Know	103,757	1,127,285	880,720	559,317	177,156
Periodicity					
same Year,	20,994	159,607	290,381	168,046	49,739
1 year	141,187	1,430,887	2,330,780	1,738,496	339,094
2 years	108,830	1,069,741	1,832,359	1,265,638	277,913
3 years	51,420	461,460	684,141	473,146	118,297
4 years or more	55,722	535,071	610,574	465,077	129,672
Type of mammogram requested					
Diagnostic Mamog.	13,971	61,121	213,363	159,100	38,132
Screening Mamog.	657,049	5,741,620	7,254,302	5,102,705	1,258,384
Type of screening mammogram					
Target population	626,901	5,489,576	6,827,542	4,582,017	1,197,181
High-risk population (family history)	20,356	187,033	285,960	417,952	39,467
Patient previously treated for breast cancer	9791	65,007	140,795	102,726	21,736
BI-RADS					
Category 0	83,567	730,384	848,254	514,091	154,796
Category 1	269,731	2,617,649	2,243,415	1,852,707	519,936
Category 2	298,586	2,319,276	4,080,142	2,716,458	572,462
Category 3	11,013	80,926	228,685	130,380	34,513
Category 4	6649	42,563	53,344	38,632	12,427
Category 5	1024	7153	10,510	7965	1921
Category 6	450	4790	3312	1548	460

Table 3. *Cont.*

Variables	Regions				
	North	Northeast	Southeast	South	Midwestern
	N				
Mammography Schedule					
Up to 30 days	305,525	3,414,961	2,927,179	2,555,095	641,771
31–60 days	167,120	1,335,074	1,938,119	1,362,978	332,154
more than 60	198,375	1,052,706	2,602,367	1,343,732	322,591
Mammography request					
Yes, right breast	25,527	157,328	242,819	194,197	55,009
Yes, left breast	28,467	165,772	257,827	219,760	59,365
Yes, both	14,819	87,392	116,558	108,079	29,169
No	602,207	5,392,249	6,850,461	4,739,769	1,152,973

Table 4 presents analyses of sociodemographic and clinical variables stratified by educational level. Associations were tested using the chi-square test (*p**), prevalence ratio (PR), and proportional distributions (%).

Table 4. Analysis of the association of sociodemographic and clinical variables according to education in Brazil (2013–2022).

Variables	Education														
	Illiterate			Elementary School Incomplete			Elementary Complete Elementary School			High School Complete			Complete Higher Education		
	%	*p* *	RP	%	*p* *	RP	%	*p* *	RP	%	*p* *	RP	%	*p* *	RP
Sex															
Male	7.53	0.493	-	43.51	0.648	-	23.85	0.600	-	22.38	0.605	-	2.72	0.085	-
Female	6.72		1.12	44.92		0.97	22.71		1.05	21.29		1.05	4.37		0.62
Age group															
Up to 9 years	3.57	<0.001	-	42.86	<0.001	-	21.43	<0.001	-	32.14	<0.001	-	0.00	<0.001	-
Between 10 and 14 years old	0.00		3.57	22.22		1.93	38.89		0.55	33.33		0.96	5.56		5.56
Between 15 and 19 years old	5.65		0.63	19.35		2.21	33.06		0.65	38.71		0.83	3.23		3.23
Between 20 and 24 years old	1.67		2.13	16.74		2.56	31.38		0.68	43.10		0.75	7.11		7.11
Between 25 and 29 years old	1.32		2.71	15.98		2.68	28.95		0.74	45.68		0.70	8.08		8.08
Between 30 and 34 years old	1.23		2.90	19.77		2.17	29.23		0.73	42.69		0.75	7.08		7.08
Between 35 and 39 years old	1.61		2.22	27.20		1.58	26.36		0.81	36.52		0.88	8.31		8.31
Between 40 and 44 years old	2.13		1.67	33.75		1.27	27.10		0.79	30.72		1.05	6.29		6.29

Table 4. *Cont.*

Variables	**Education**														
	Illiterate			**Elementary School Incomplete**			**Elementary Complete Elementary School**			**High School Complete**			**Complete Higher Education**		
	%	***p*** *	**RP**	**%**	***p*** *	**RP**	**%**	***p*** *	**RP**	**%**	***p*** *	**RP**	**%**	***p*** *	**RP**
Between 45 and 49 years old	2.87		1.24	38.77		1.11	25.86		0.83	26.88		1.20	5.62		5.62
Between 50 and 54 years old	4.54		0.79	44.51		0.96	24.56		0.87	21.47		1.50	4.92		4.92
Between 55 and 59 years old	6.25		0.57	50.59		0.85	21.51		1.00	18.08		1.78	3.58		3.58
Between 60 and 64 years old	10.30		0.35	52.95		0.81	19.54		1.10	14.32		2.25	2.90		2.90
Between 65 and 69 years old	14.09		0.25	56.48		0.76	16.61		1.29	10.78		2.98	2.05		2.05
Between 70 and 74 years old	15.53		0.23	56.71		0.76	15.68		1.37	10.83		2.97	1.26		1.26
Between 75 and 79 years old	18.34		0.19	54.10		0.79	16.50		1.30	10.00		3.22	1.06		1.06
Over 79 years old	23.27		0.15	50.35		0.85	14.65		1.46	10.15		3.17	1.59		1.59
High risk (family history)															
Yes	7.03			46.65		-	22.17		--	19.90		-	4.25		
No	9.60	<0.001	0.73	5.77	<0.001	8.08	2.62	<0.001	8.47	1.92	<0.001	10.34	0.43	<0.001	9.91
Do Not Know	3.95		1.78	8.45		5.52	5.98		3.71	7.03		2.83	1.25		3.40
Periodicity															
Same year.	5.63			43.26		-	22.82		-	23.67			4.62		-
1 year	5.06		1.11	44.59		0.97	22.97		0.99	22.51		1.05	4.86		0.95
2 years	4.93	<0.001	1.14	43.76	<0.001	0.99	25.80	<0.001	0.88	21.19	<0.001	1.12	4.32	0.038	1.07
3 years	5.83		0.97	47.13		0.92	21.84		1.04	20.70		1.14	4.50		1.03
4 years or more	7.01		0.80	47.62		0.91	20.07		1.14	20.67		1.14	4.63		1.00
Type of mammogram requested															
Mamog. Diagnosed	3.81	<0.001		0.35	<0.001	-	0.27	<0.001	-	29.02	<0.001	-	5.67	<0.001	-
Mamog. Screening	6.80		0.56	0.45		0.77	0.23		1.17	21.08		1.38	4.33		1.31
Type of screening mammogram															

Table 4. *Cont.*

Variables	Education														
	Illiterate			Elementary School Incomplete			Elementary Complete Elementary School			High School Complete			Complete Higher Education		
	%	*p* *	RP	%	*p* *	RP	%	*p* *	RP	%	*p* *	RP	%	*p* *	RP
Target population	7.19	<0.001		46.83	<0.001		22.16	<0.001		19.52	<0.001		4.29	0.047	
High-risk population (family history)	2.52		2.86	26.77		1.75	27.63		0.80	38.49		0.51	4.59		0.93
Patient previously treated for breast cancer	6.93		1.04	50.24		0.93	20.46		1.08	16.88		1.16	5.49		0.78
BI-RADS															
Category 0	6.16	<0.001	-	44.59	<0.001	-	22.86	<0.001	-	21.18	<0.001	-	5.22	<0.001	-
Category 1	4.74		1.30	40.77		1.09	25.36		0.90	24.52		0.86	4.62		1.13
Category 2	8.56		0.72	48.54		0.92	20.34		1.12	18.60		1.14	3.96		1.32
Category 3	6.61		0.93	45.57		0.98	23.35		0.98	19.80		1.07	4.66		1.12
Category 4	6.56		0.94	44.38		1.00	23.47		0.97	21.25		1.00	4.34		1.20
Category 5	9.22		0.67	49.31		0.90	22.12		1.03	16.59		1.28	2.76		1.89
Category 6	6.06		1.02	48.48		0.92	18.18		1.26	24.24		0.87	3.03		1.72
Exam Schedule															
Up to 30 days	6.95	<0.001	-	40.15	<0.001	-	23.08	<0.001	-	25.29	<0.001	-	4.54	0.013	-
31–60 days	6.81		1.02	49.10		0.82	22.10		1.04	17.69		1.43	4.29		1.06
more than 60	6.29		1.10	48.58		0.83	22.67		1.02	18.30		1.38	4.16		1.09
Mammography request															
Yes, right breast	4.82	<0.001	-	42.14	<0.001	-	25.00	<0.001	-	23.25	<0.001	-	4.80	<0.001	-
Yes, left breast	4.74		1.02	41.91		1.01	24.70		1.01	22.90		1.02	5.75		0.83
Yes, both	4.37		1.10	37.31		1.13	21.78		1.15	29.84		0.78	6.70		0.72
No	6.91		0.70	45.27		0.93	22.56		1.11	21.00		1.11	4.25		1.13

* Chi-square. RP = Prevalence Ratio.

Figure 2 estimates mammography coverage by federative unit and geographic region, highlighting regional disparities in screening coverage, based on data from IBGE and SISCAN (2013–2022). Coverage was calculated using the following formula:

$$\text{Coverage (\%)} = (\text{Number of mammograms performed}/\text{Target female population [50–69 years]}) \times 100$$

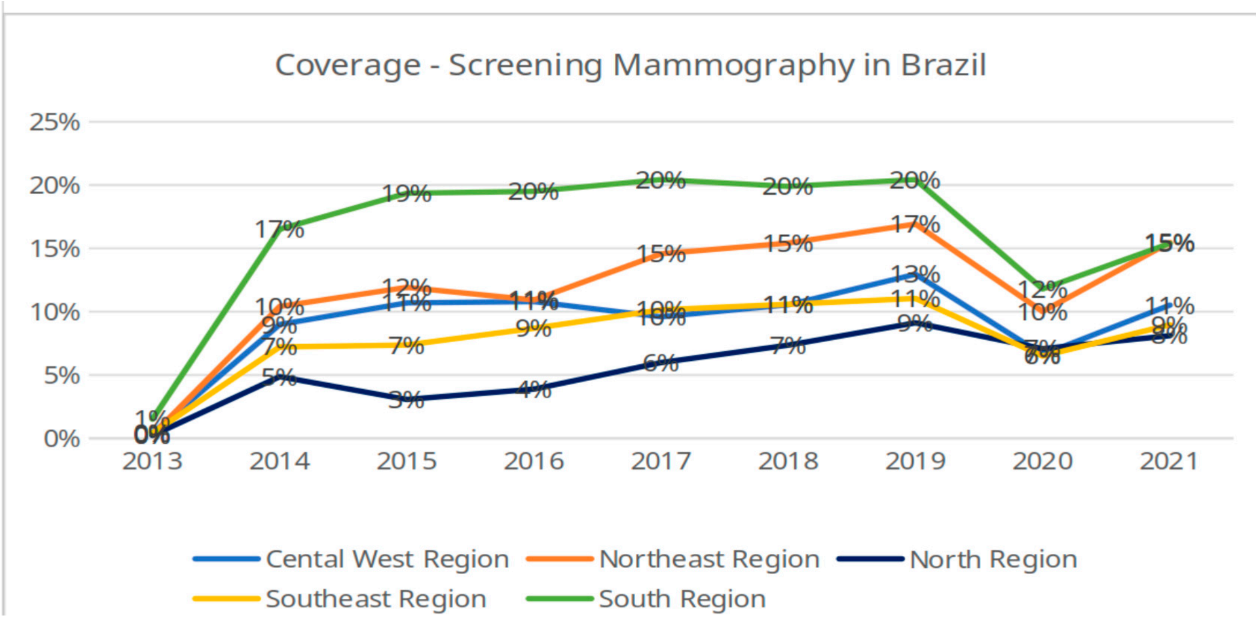

Figure 2. Description of the percentage of coverage of screening mammography in Brazil (2013–2021).

3. Results

Between 2013 and 2022, a total of 22,526,724 mammographic examinations were recorded in Brazil (Table 1). Although some examinations were performed in men, the vast majority occurred in women. Over the study period, requests for diagnostic mammography increased; however, overall coverage remained below the desired levels.

The age group with the highest prevalence of mammography was 50–69 years, in accordance with national screening recommendations. Uptake increased progressively between 2013 and 2019, followed by a marked decline in 2020 and a recovery in subsequent years. Women aged 40–49 years also represented a significant proportion of examinations performed.

In addition, a notable subgroup consisted of high-risk patients, defined by a positive family history of breast cancer and patients previously treated for the disease, who underwent earlier and more frequent screening examinations according to clinical guidelines.

Regarding periodicity, despite the Ministry of Health recommending biennial screening, annual mammography predominated in practice.

3.1. Education

Analysis by education level demonstrated a direct relationship between schooling and mammography uptake (Table 2). Illiterate women presented the lowest rates, whereas prevalence increased progressively from incomplete elementary education to complete high school. A decline was observed among women with higher education; however, when population distribution was considered, the relative rate of examinations in this group was proportionally higher.

3.2. Regional Distribution

Marked regional disparities were observed (Table 3). The Southeast and Northeast concentrated the largest number of examinations, while the North presented the lowest coverage, except in 2020, when the Southeast recorded the poorest performance. The South achieved the highest coverage in 2019 (20.44%), although no region reached 50% of the target population in any of the years assessed.

3.3. Association with Sociodemographic and Clinical Variables

Statistical analyses confirmed a significant association between education level and mammography prevalence (Table 4). The chi-square test showed significance ($p < 0.05$), and prevalence ratios indicated greater uptake with higher education. These findings were consistent across age groups, risk categories, periodicity, type of mammogram, BI-RADS classification, and waiting times

3.4. Coverage

National coverage of the target population remained critically low throughout the study period (Graph 1). In 2013, coverage was only 0.47%, with gradual increases in subsequent years, peaking in 2019 (13.25%). The year 2020 marked the most significant decline, with reductions of at least 20% in all regions compared with 2019.

Regionally, the South and Northeast achieved the highest coverage, while the North consistently presented the lowest rates in most years. Nevertheless, no region surpassed 50% of the target population during the study period.

4. Conclusions

The findings of this study demonstrate that, although biennial mammography for women aged 50 to 69 years is the strategy recommended by the Brazilian Ministry of Health to reduce breast cancer mortality, coverage in Brazil remains far below the ideal. In none of the years evaluated did adherence reach half of the target population, reflecting significant disparities determined by socioeconomic, educational, and structural factors.

Mammography uptake was shown to be directly proportional to educational level [15,16], with populations of lower schooling and reduced socioeconomic status remaining underrepresented due to barriers such as limited access to information on disease signs and symptoms, poor understanding of the benefits of screening, low self-perception of health, lack of time, beliefs regarding breast care, embarrassment, fear of discomfort during the procedure, difficulties in making informed health decisions, long distances, and challenges in scheduling consultations and/or examinations [17,18]. This scenario constitutes a public health problem, favoring late diagnoses and poorer clinical outcomes.

Regional analysis revealed marked inequalities. Only 21.8% of Brazilian municipalities have at least one mammography unit, with an average of 4.7 devices per city. The Southeast region concentrates nearly half (47.4%) of the country's equipment, followed by the Northeast (22.2%), South (15.7%), Midwest (8.5%), and North (6%) [16]. Such discrepancies reflect not only inequality in equipment distribution but also differences in technological quality, availability of qualified professionals, scheduling logistics, waiting times, equipment maintenance, and hospital infrastructure [19]. These factors, combined with socioeconomic inequalities and demographic density, directly impact the effectiveness of screening [20].

Furthermore, Brazil's regional heterogeneity, marked by historical inequalities and its continental dimensions, imposes additional challenges to achieving equity in mammographic screening. While more developed regions, such as the South and Southeast, show higher coverage indicators, the North remains with the lowest rates, evidencing the combined effects of logistical barriers, unequal access, and educational differences. In addition, racial inequalities further hinder adherence to screening.

In conclusion, the challenges to effective early detection of breast cancer in Brazil are intrinsically related to educational, socioeconomic, racial, and regional disparities, exacerbated by the country's continental dimensions and the heterogeneous distribution of healthcare resources. These results reinforce the urgent need for differentiated public strategies that address not only the technical guidelines for screening but also regional and social specificities, in order to expand coverage, reduce inequalities, and optimize the impact of mammographic screening on breast cancer mortality reduction.

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Informed Consent Statement: Not applicable.

Data Availability Statement: The data used in this study are entirely publicly available and were obtained from official open-access databases provided by the Brazilian Ministry of Health and the Brazilian Institute of Geography and Statistics (IBGE). Clinical and epidemiological data were accessed through SISCAN via the DATASUS/TABNET platform (https://datasus.saude.gov.br/informacoes-de-saude-tabnet/) (accessed on 10 September 2025). Demographic and socioeconomic information was obtained from IBGE's Resident Population Estimates (https://www.ibge.gov.br/estatisticas/sociais/populacao.html) (accessed on 10 September 2025). All datasets are fully anonymized and contain no personally identifiable information. No new data were generated specifically for this study.

Conflicts of Interest: The authors have no conflicting interests to declare that are relevant to the content of this article.

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