

Clinicopathological profile, diagnostic and treatment intervals, and outcomes of breast cancer in a SUS-based Brazilian regional cohort (2005–2020)

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ABSTRACT

Introduction: Breast cancer is the most commonly diagnosed cancer in women worldwide. In Brazil, it is characterized by regional heterogeneity in incidence, stage at diagnosis, and access to treatment. This study aimed to describe the clinicopathological profile, treatments, and common outcomes of breast cancer patients treated at a SUS-based referral center, and to evaluate associations between age at diagnosis and disease stage, tumor characteristics, and outcomes. **Methods:** Clinical, pathological, treatment, and outcome data were collected from medical records of 300 patients diagnosed with breast carcinoma between the years of 2005 and 2020. **Results:** 36.4% of patients were younger than 50 years. The initial mode of detection was clinical presentation in 75.7% of cases. Mean tumor size was 28.7 mm ($\pm$ 19.4). The most common stages were II and I (47.4% and 25.0%, respectively). The median diagnostic interval was 48 days (IQR 34–75.75) and the median treatment interval was 33 days (IQR 25–48.75). Over a median follow-up of 56.0 months, 12 deaths were recorded (274 censored); over a median follow-up of 60.0 months, 35 recurrences were recorded (230 censored). **Conclusions:** These findings highlight that a substantial proportion of breast cancer cases occurred in women younger than 50 years and support further population-based studies to inform age-specific screening strategies in Brazil. The diagnostic interval exceeded the 30-day target referenced by Brazilian federal legislation. This study provides descriptive, real-world data on the clinicopathological profile and care pathway of breast cancer patients diagnosed and treated within a regional, SUS-based cohort.

KEYWORDS: breast cancer; prognosis; age groups, public health.

INTRODUCTION

Breast cancer (BC) is the most frequently diagnosed malignancy in women worldwide, and the leading cause of cancer-related death in this population. According to GLOBOCAN 2022, there were approximately 2.3 million new cases and 666,000 deaths globally in that year, reinforcing its status as a major public health priority¹. In Brazil, the Instituto Nacional do Câncer (INCA) estimated 73,610 new cases for the 2023-2025 triennium, representing the most common malignancy in Brazilian women excluding non-melanoma skin cancers². Mortality rates in Brazil have shown a distinct regional pattern, with higher rates observed in the South and Southeast, and growing trends in the North and Northeast over the past two decades³.

Since September 2025, the Brazilian Ministry of Health has recommended biennial population screening for women aged 50

to 74 years, according to a technical note issued by the Ministry of Health⁴; access to mammography outside this age range may occur through shared decision-making rather than organized population screening. The Brazilian Society of Mastology, however, advocates for extending organized screening coverage to include women aged 40 to 49, given the proportionally higher burden of BC in younger age groups observed in national cohorts^{5,6}. During the study period, routine population screening within the SUS did not target women younger than 50 years of age.

Breast cancer in younger women tends to present with more aggressive biological characteristics, including higher histological grade, greater frequency of hormone receptor-negative and HER-2-positive subtypes, and elevated Ki-67 proliferative index, features independently associated with worse prognosis regardless of treatment modality^{7,8}. Access to oncological care in Brazil also differs substantially between SUS-covered and private insured

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patients, with SUS-treated patients showing higher rates of advanced-stage presentation and longer intervals between diagnosis and treatment initiation^{9,10}. These biological and systemic determinants underscore the need for locally derived data on the clinicopathological profile of BC within SUS-based referral settings, where the vast majority of Brazilian women receive care. Studies show significant differences in treatment and prognosis between patients treated through SUS and those with supplementary health coverage⁹. Early detection and appropriate treatment are crucial for improving survival rates and reducing mortality.

This study aimed to describe the clinicopathological profile, treatment modalities, and clinical outcomes of BC patients treated at a SUS-based reference center in the microregion of Lavras, Minas Gerais, between 2005 and 2020. Secondary objectives included evaluating the association between age at diagnosis, disease stage, tumor size, and describing overall survival and disease-free survival, including the number of events, censored patients, as well as follow-up time. The data generated are intended to inform local health policy regarding screening coverage, diagnostic pathways, and resource allocation for breast cancer care in Brazilian microregional settings.

METHODS

A retrospective, observational cohort study conducted through the analysis of medical records of breast cancer patients treated between January 1, 2005, and December 31, 2020, at the CEAE (Centro Estadual de Atenção Especializada) institution, a reference in mastology care in the unified health system (SUS) of the city of Lavras and its microregion. The Lavras microregion comprises ten municipalities: Lavras, Nepomuceno, Ijaci, Itumirim, Luminárias, Carrancas, Ribeirão Vermelho, Itutinga, Perdões and Ingai.

Data collection began after approval of the research project by the Ethics Committee in Research with Human Beings of UFLA (Federal University of Lavras), under the Certificate of Presentation of Ethical Assessment (CAAE): 36285320.2.0000.5148. This complied with Resolution 466/2012 of the National Health Council of the Ministry of Health, which provides guidelines and regulatory standards for human research.

Data was obtained using an objective structured form, with a total number of 316 patients. The inclusion criteria were women with a histological diagnosis of breast cancer, aged 18 years or older, who attended and had medical records at the CEAE institution from 2005 to 2020. The exclusion criteria were patients whose analyzed medical records did not contain the information necessary to obtain the data.

Tumor staging was based on anatomic TNM classification according to the American Joint Committee on Cancer (AJCC) 8th edition; the AJCC prognostic staging system, which additionally incorporates biomarker status (ER, PR, HER2) and histological

grade, was not used. To ensure comparability across the study period, all cases diagnosed from 2005 to 2020 were retrospectively classified according to anatomic AJCC 8th-edition criteria using the clinical, imaging, and pathological information available in the medical records. Stage at diagnosis was defined according to the initial clinical evaluation before the initiation of any systemic therapy. For patients receiving neoadjuvant chemotherapy, clinical TNM (cTNM) obtained before treatment was used for staging, and post-treatment pathological stage was not used in the analyses. Tumor size corresponded to the largest pretreatment tumor diameter obtained from imaging studies; in patients undergoing primary surgery, pathological tumor size was used when no neoadjuvant treatment had been administered.

Regarding the data collected, the criteria used to classify the menopausal status were based on the definition of postmenopausal, which corresponds to the framing into one of four groups: women aged 60 years or older; women who underwent bilateral oophorectomy; women without a uterus who had laboratory tests confirming an increase in follicle-stimulating hormone (FSH); and women under 60 years of age, with an intact uterus, not receiving hormone therapy, with amenorrhea for at least 12 months before diagnosis of breast cancer. Outside the situations described, the classification was pre-menopause; no patient had insufficient information to apply this classification. A positive family history was defined as a documented history of breast cancer in the patient's mother and/or sister. Immunohistochemistry-based surrogate subtypes were determined using estrogen receptor (ER), progesterone receptor (PR), HER2, and Ki-67 expression according to the 2013 St. Gallen International Expert Consensus. ER and PR positivity were defined as $\geq 1\%$ positively stained tumor nuclei. HER2 status was assessed according to the pathology report following the applicable ASCO/CAP recommendations during the study period. Equivocal (2+) HER2 cases were confirmed by *in situ* hybridization whenever available. Ki-67 was expressed as the percentage of positively stained invasive tumor cells, as reported by the original pathology laboratory. Pathological information was obtained from the original reports, and no centralized pathology review was performed. Tumors were classified into immunohistochemistry-based surrogate subtypes as Luminal A-like, Luminal B-like (HER2-negative), Luminal B-like (HER2-positive), HER2-enriched, and triple-negative according to the St. Gallen 2013 surrogate definitions^{11,12}.

The diagnostic interval was defined as the time between the first medical consultation on record that initiated the investigation of the breast lesion and the date of histopathological confirmation. Treatment interval was defined as the time between histopathological confirmation and the initiation of the first cancer-directed treatment (surgery, neoadjuvant systemic therapy, or other oncologic treatment, as appropriate).

Overall survival was defined as the interval between the date of histopathological diagnosis and death from any cause.

Patients alive at the last available follow-up were censored at that date. Disease-free survival was defined as the interval between primary treatment and the first documented local, regional, or distant recurrence. Local, regional, and distant recurrence were defined according to the anatomical site of first documented relapse (in or adjacent to the treated breast/chest wall; regional lymph node basins; or distant organs, respectively), as recorded in the medical record. Patients without recurrence were censored at the date of the last clinical follow-up. Patients whose follow-up records did not allow determination of time-to-event outcomes were excluded from the corresponding survival analyses. Disease-free survival analyses were restricted to patients with invasive nonmetastatic breast cancer treated with curative intent. Patients with ductal carcinoma in situ and de novo metastatic disease were excluded from recurrence analyses. The administrative study end date, used as the reference for censoring patients without an event, was 31 December 2020.

Statistical analysis

All statistical analyses were performed using the R software, version 4.6.1 (R Core Team, 2026). For descriptive analysis, quantitative variables were presented as means and standard deviations, or as medians and interquartile ranges (IQR), and qualitative variables as absolute and relative frequencies. Overall survival and disease-free survival were summarized descriptively, reporting the number of events, the number of censored patients, and the median follow-up time; the latter was estimated using the reverse Kaplan-Meier method, with 95% confidence intervals calculated from Greenwood's variance estimator using the log-log transformation. Given the limited number of events and the long, 16-year study period, during which treatment practices evolved substantially, no between-group comparisons or regression models (e.g., log-rank tests or Cox proportional-hazards regression) were performed for survival outcomes. Categorical comparisons unrelated to time-to-event outcomes were assessed using Fisher's exact test. A two-sided $p < 0.05$ was considered statistically significant.

RESULTS

Between January 2005 and December 2020, 316 women with a histological diagnosis of breast carcinoma were identified at the CEAE reference center. Of these, 16 (5.1%) were excluded: 11 due to insufficient data for analysis, and 5 due to referral to another treatment center before completion of follow-up. These five patients otherwise met the histological, age, and institutional inclusion criteria, but continuity of care and follow-up at CEAE could not be ensured after transfer, precluding reliable ascertainment of treatment and outcome data. The final sample comprised 300 women who met the remaining inclusion criteria and had sufficient documented data for analysis (Figure 1).

General clinical and epidemiological characteristics are presented in Table 1. The mean age at diagnosis was 54.2 years (± 12.4), and the median age was 53 years. Two hundred and four patients belonged to the municipality of Lavras, and 96 of them belonged to the municipalities of this microregion. The group of patients younger than 50 years accounted for 36.4% of the total (109 patients), while the group aged ≥ 50 years accounted for 63.6% of the sample (191 patients). The distribution by age group is shown in Figure 2.

Invasive carcinoma accounted for 281 of 300 cases (93.7%), whereas 19 patients (6.3%) had ductal carcinoma in situ. Immunohistochemistry-based surrogate luminal subtypes (Luminal A-like, Luminal B-like HER2-negative, and Luminal B-like HER2-positive) represented most tumors (247/299, 82.6%). The clinicopathological characteristics are presented in Table 2.

The mean tumor size was 28.7 mm (± 19.4). Tumor size information was available for 279 of the 281 invasive carcinomas. Among these patients, 106 out of 279 (38.0%) had tumors measuring ≤ 2.0 cm, 144/279 (51.6%) had tumors measuring 2.1–5.0 cm, and 29/279 (10.4%) had tumors > 5.0 cm.

The distribution by stage at diagnosis showed that most patients were diagnosed in stages II and I (47.4% and 25.0%, respectively). Ductal carcinoma in situ (stage 0) represented 6.3% of cases ($n=19$), locally advanced tumors (stage III) represented

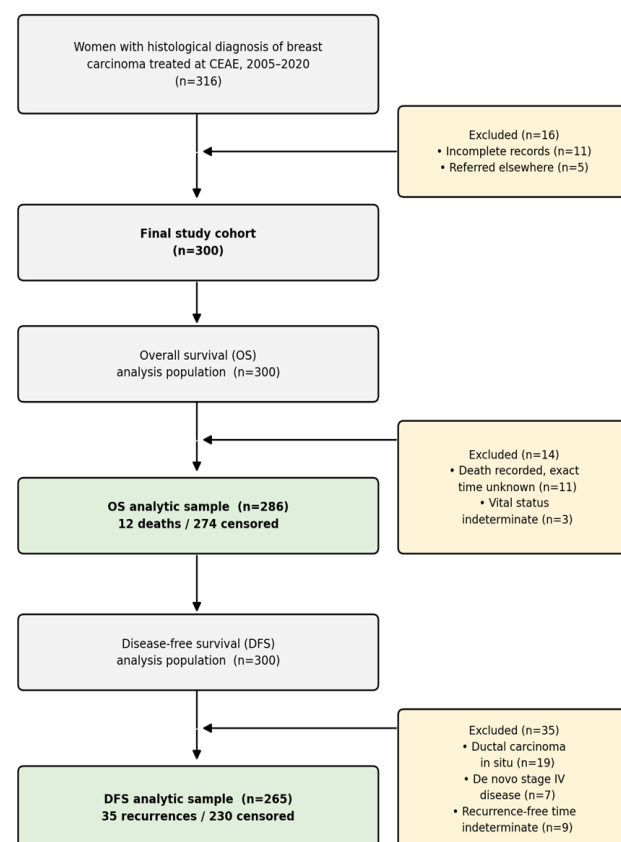
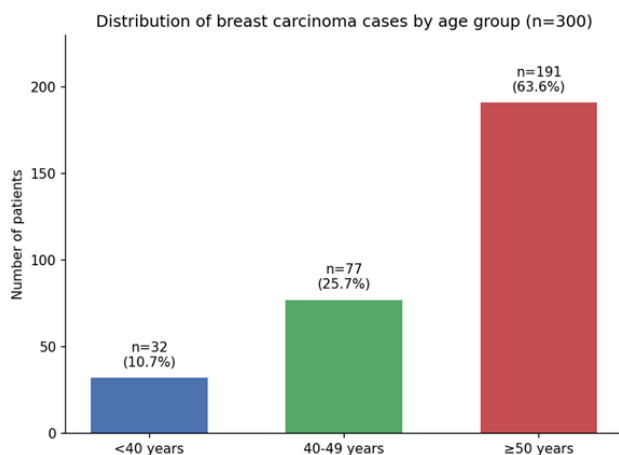


Figure 1. STROBE flowchart of study selection and sample composition.

Table 1. Clinical and epidemiological characteristics of the study population.

Characteristic	Category	N	%
Parity	Nulliparous	44	14.7
	Primiparous	43	14.3
	Multiparous	213	71.0
Menopausal status	Premenopausal	117	39.0
	Postmenopausal	183	61.0
Breastfeeding history	Yes	232	77.3
	No	68	22.7
Smoking	Yes	69	23.0
	No	231	77.0
Family history of breast cancer (mother and/or sister)	Yes	42	14.0
	No	258	86.0
Mode of detection	Clinical detection	227	75.7
	Imaging detection	73	24.3
Clinical presentation	Occult breast cancer	3	1.0
Type of lesion detected	Nodule	262	87.3
	Microcalcification	31	10.4
	Focal asymmetry	3	1.0
	Axillary lymphadenopathy	2	0.7
	Nipple ulceration	1	0.3
	Complex cyst	1	0.3

Note: Mode of detection (Clinical detection vs. Imaging detection) sums to the full cohort (n=300). The three occult breast cancer cases are a clinical subset already included within the Clinical detection category (n=227) and are listed separately only to describe this atypical presentation; they are not an additional, non-overlapping category.

**Figure 2.** Distribution of breast carcinoma cases analyzed by age group (n=300).

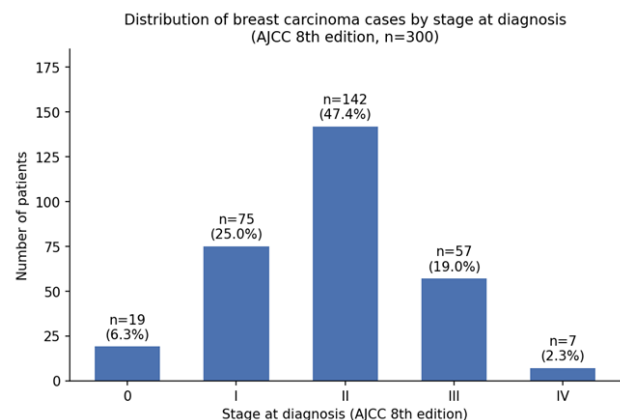
19.0% (n=57), and de novo metastatic disease (stage IV) represented 2.3% (n=7) of the total (Figure 3).

Regarding the surgical treatment performed, 10/300 patients (3.3%) did not undergo surgery. Among the 290/300 patients who did, 235/290 (81.0%) had breast-conserving surgery and 55/290 (19.0%) received a total mastectomy. Of the 55 patients who underwent

Table 2. Clinicopathological characteristics of the study population.

Characteristic	Category	n/N	%
Histological type*	Invasive ductal carcinoma	250/297	84.2
	Invasive lobular carcinoma	25/297	8.4
	Mucinous carcinoma	6/297	2.0
	Medullary carcinoma	6/297	2.0
	Papillary carcinoma	4/297	1.4
	Mixed invasive carcinoma (ductal + lobular)	4/297	1.4
	Apocrine carcinoma	1/297	0.3
	Metaplastic carcinoma	1/297	0.3
ER	Positive	245/300	81.7
	Negative	55/300	18.3
PR	Positive	224/300	74.7
	Negative	76/300	25.3
HER2 status	Positive	52/300	17.3
	Negative	248/300	82.7
Immunohistochemistry-based surrogate subtype	Luminal A-like	94/299†	31.5
	Luminal B-like (HER2-negative)	120/299†	40.1
	Luminal B-like (HER2-positive)	33/299†	11.0
	HER2-positive (non-luminal)	20/299†	6.7
	Triple-negative	32/299†	10.7
Histological grade‡	Grade 1	42/298	14.1
	Grade 2	179/298	60.1
	Grade 3	77/298	25.8
Type of carcinoma	Invasive	281/300	93.7
	In situ	19/300	6.3

ER: estrogen receptor; PR: progesterone receptor; HER2: human epidermal growth factor receptor 2. *Percentages for histological type were calculated using 297 patients, excluding the three cases of occult breast cancer, which represent a clinical presentation rather than a histological subtype. †One patient had incomplete immunohistochemical data; therefore, percentages were calculated using 299 patients. ‡Histological grade was available for 298 patients.

**Figure 3.** Distribution of breast carcinoma cases by stage at diagnosis (AJCC 8th edition, n=300).

total mastectomy, immediate breast reconstruction was performed on 22/55 (40.0%). Radiotherapy was performed in 266/300 patients (88.7%). Chemotherapy was performed in 212/300 patients (70.7%): 65.1% in the adjuvant setting, 33.0% in the neoadjuvant setting, and 1.9% as palliative treatment; 88/300 patients (29.3%) did not receive chemotherapy. Hormone therapy was used by 234/300 patients (78.0%), while 66/300 patients (22.0%) did not receive hormonal treatment.

The median interval from the first clinical appointment that initiated the diagnostic investigation to histological confirmation of breast carcinoma was 48 days (IQR 34–75.75), with a mean of 63.2 days (SD±48.1), exceeding the 30-day target established by Federal Law No. 13.896/2019¹³. The median interval from histological diagnosis to initiation of treatment was 33 days (IQR 25–48.75), with a mean of 39.6 days (SD±29.8), within the 60-day limit established by Federal Law No. 12.732/2012 and regulated by Ministry of Health Ordinance No. 876/2013¹⁴. Although the first observed interval was longer than the 30-day diagnostic target currently established in Brazilian legislation, the definition of diagnostic interval was based on the first documented consultation initiating diagnostic investigation and therefore it may not be directly equivalent to the legal benchmark. Similarly, the legal 60-day requirement to initiation of treatment was implemented during the study period.

Disease recurrence was documented in 37/300 patients (12.3%). Recurrence patterns included distant recurrence in 22/37 (59.5%), local recurrence in 10/37 (27.0%), regional (axillary) recurrence in 2/37 (5.4%), and concomitant local and distant recurrence in 2/37 (5.4%). One additional patient (1/37, 2.7%) was recorded in the medical record as a possible contralateral new primary tumor rather than an unambiguous recurrence. Overall, 23/300 patients (7.7%) died during the analysis period.

For 11 of the 23 patients with documented deaths, the exact timing of death and vital status could not be verified from hospital records, and vital status itself was indeterminate for 3 other patients. These 14 patients were excluded from the overall survival analysis, leaving an analytic sample of 286 patients (12 deaths, 274 censored). Median follow-up, estimated using the reverse Kaplan-Meier method, was 56.0 months (95%CI 48–66). Similarly, of the 300 patients, 19 with ductal carcinoma in situ and 7 with de novo stage IV disease were excluded from the disease-free survival analysis by definition, and a further 9 patients were excluded as the exact interval to recurrence or to the last disease-free contact could not be determined; the disease-free survival analytic sample comprised 265 patients (35 recurrences, 230 censored), with a median follow-up of 60.0 months (95%CI 50–72).

There was no significant difference between tumor size and age at diagnosis ($p=0.111$; 95%CI -0.21–0.02). Similarly, age was not related to differences in disease staging at diagnosis when comparing earlier stages (0, I and II) with more advanced stages (III and IV) ($p=0.289$; 95%CI 0.38–1.36), nor when comparing women younger than 50 years with those aged ≥ 50 years ($p=0.231$, 95%CI 0.73–2.58).

DISCUSSION

This retrospective cohort study provides a comprehensive characterization of the clinicopathological profile and outcomes of BC in a SUS-based referral center serving a Brazilian microregion over 16 years. These findings complement those of large multicenter Brazilian studies such as AMAZONA¹⁵ by offering granular real-world data from a regional, predominantly public health system setting, a perspective that remains underrepresented in the national literature.

Just as the etiology of BC is multifactorial, the presentation and outcomes are also influenced by several factors¹⁶. A substantial proportion of patients (36.4%) were diagnosed before the age of 50, a finding consistent with data from the multicenter Brazilian AMAZONA study, in which 41.1% of 2,296 patients were diagnosed before this age threshold, and with other Latin American cohorts demonstrating earlier breast cancer onset compared with North American and European populations^{15,17,18}. The mean age at diagnosis in the United States and Germany is reported at 62 and 63 years, respectively, compared with 54.2 years in our cohort. Similarly, based on data from two large health institutions, Orlandini et al. reported a high prevalence of BC among young women in Brazil¹⁹.

This epidemiological pattern raises a hypothesis for future investigation, rather than an established policy conclusion, regarding earlier initiation of screening in this population; approximately one-third of the patients analyzed in the current study were younger than 50 years, an age range in which access to mammography in Brazil currently depends on shared decision-making rather than organized population screening. This hypothesis should also be considered in the context of the long, 16-year inclusion period of this cohort (2005–2020), during which screening recommendations and clinical practice evolved substantially.

Although this observation raises important questions regarding the age at which screening strategies should begin, the present study was not designed to evaluate the effectiveness of initiating mammographic screening at age 40; this retrospective cohort has no population denominator, screening-participation data, or comparison group. Population-based studies can more accurately determine the potential impact of different age-specific screening strategies on the stage at diagnosis and on mortality.

We found a predominance of diagnoses of stage II disease (47.4% of cases). The low detection rate at stage 0 (6.3%) reflects the need for improvements in the coverage and effectiveness of the local screening program. In the AMAZONA study, most cases were stage II or III. A comparison of our data with those obtained by Simon and coworkers shows the following respective rates: stage II, 47.3% versus 53.5%, and stage III, 19.0% versus 23.2%. The former percentages of initial diagnosis are lower than those of developed countries, and this impacts both the results and therapeutic costs¹⁵. In a systematic review evaluating treatment costs, the mean costs of treatment for stages II, III and IV BC were 32%,

95% and 109% higher than for stage I disease²⁰. Improvement in the stage of detection is therefore associated with better prognosis and cost reduction, an important consideration in the scenario of developing and underdeveloped countries.

The median interval between the medical appointment that led to the investigative process and the histological diagnosis was 48 days (IQR 34–75.75), above the 30-day period referenced by Brazilian federal legislation¹³. This interval represents an important target for improvement in the care pathway; however, this study did not evaluate the relationship between diagnostic interval and stage at diagnosis or clinical outcomes, and no causal inference regarding diagnostic delay and prognosis should be drawn from these descriptive data. The median time between histological diagnosis and initiation of treatment was 33 days (IQR 25–48.75). Data from a recently published national study showed that, in Brazil, the average time to treatment initiation is 56 days in the SUS²¹. The implementation of a patient navigation program has already been shown to be effective in other settings and may significantly contribute to the improvement of the diagnosis-treatment process^{22,23}.

A particularly noteworthy finding was the high rate of breast-conserving surgery (BCS) in our cohort (235/290 operated patients, 81.0%), substantially higher than the 44.4% reported in the AMAZONA study and the 53.7% observed in a national SUS cohort by Freitas-Junior et al.^{15,24}. Although the present study was not designed to evaluate the reasons for this higher rate, possible explanations include the relatively high proportion of early-stage disease in our cohort, the characteristics of the institution as a specialized breast care referral center, and the progressive adoption of oncoplastic surgical techniques during the study period; these remain possible explanations rather than demonstrated causal factors. BCS is currently considered the standard of care for early BC, with oncological outcomes equivalent or superior to mastectomy when combined with radiotherapy^{25,26} and our rates suggest that this evidence-based practice has been effectively implemented in the studied service. The study period encompassed substantial changes in BC management, including increased use of neoadjuvant systemic therapy, advances in breast-conserving and oncoplastic surgery, improvements in radiotherapy techniques, and broader availability of immediate breast reconstruction. These temporal changes may have influenced treatment patterns and clinical outcomes and should be considered when interpreting the findings herein.

Among patients who underwent total mastectomy, immediate breast reconstruction was performed in 40.0%, a rate substantially higher than the 29.2% reported in a national SUS cohort by Freitas-Junior et al.²⁴. This finding suggests that the CEAE has achieved a higher standard of reconstructive care than the national average, possibly reflecting the availability of dedicated surgical expertise and institutional protocols, though this explanation remains possible rather than demonstrated.

Offering immediate reconstruction whenever oncologically feasible is considered best practice, as it reduces the number of surgical procedures, shortens the overall treatment timeline, and is associated with improved patient-reported outcomes and body image satisfaction²⁷.

No significant differences were found when evaluating the relationships among age, stage at diagnosis, and tumor size. Given the limited number of events and the long, 16-year study period, during which treatment practices evolved substantially, formal comparisons of survival outcomes according to age or stage were not performed in this cohort; overall survival and disease-free survival are instead reported descriptively. Using data from the Surveillance, Epidemiology, and End Results (SEER) Program involving 271,173 North American women with stage I-III breast cancer between 2010 and 2015, Kim et al. found a higher mortality rate in young women and reported that advanced stage was associated with a higher risk of death²⁸. Histological grade and Ki-67 proliferative index are also well-established prognostic factors for BC recurrence and survival in larger cohorts, including a retrospective series of 2,573 patients reported by Liang et al.²⁹ and the recommendations of the International Ki67 in Breast Cancer Working Group³⁰. These and other prognostic associations, such as those between stage, tumor size, and outcomes, are well established in the literature; the main contribution of this study does not lie in testing these established relationships but in providing descriptive, real-world clinicopathological and care-pathway data from an underrepresented SUS-based regional setting.

This study presents several limitations that must be acknowledged. First, the retrospective design relying on medical records introduces risk of information bias, particularly regarding variables not systematically recorded across the 16-year period, such as comorbidities, adherence to treatment, and cause of death. Second, molecular subtype classification was performed exclusively by immunohistochemistry (IHC) without genomic validation; although IHC remains the standard diagnostic tool in Brazilian public health settings, its concordance with gene expression profiling is imperfect, particularly for the distinction between Luminal A and Luminal B subtypes. Third, the St. Gallen consensus criteria for immunohistochemistry-based surrogate subtype evolved throughout the study period (2005–2020), and earlier classifications may not be fully concordant with current definitions. Fourth, the modest sample size ($n=300$) and the small number of observed events (12 deaths, 35 recurrences) limited statistical power; due to this reason, survival outcomes were reported descriptively, without formal between-group comparisons or regression modeling. Fifth, cause-specific mortality data and a documented source for date of death were unavailable in the dataset made available for this analysis, preventing distinction between breast cancer-related and all-cause mortality. Sixth, the single-center design restricts the generalizability of findings to other microregional settings in Brazil. Finally, due to

the limited number of outcome events, adjustment for calendar year or stratified analyses according to treatment period were not performed, despite substantial changes in BC management over the 16-year study period. Future studies with larger cohorts should evaluate the impact of temporal changes in BC management on clinical outcomes.

CONCLUSION

This study provides a descriptive, real-world characterization of the clinicopathological profile and diagnostic and treatment intervals of a SUS-based regional breast cancer cohort followed over 16 years. In this single-center, SUS-based regional cohort, 36.4% of cases occurred in women younger than 50 years, and the observed median interval to diagnosis of 48 days exceeded, but was not directly equivalent to, the statutory 30-day interval referenced in Brazilian federal legislation, identifying a potential bottleneck in the care pathway that warrants further, prospectively designed evaluation. Given the retrospective, single-center design, the long and heterogeneous study period, and the limited number of events, survival and recurrence outcomes

were reported descriptively rather than through comparative or regression-based analyses.

Within these constraints, our findings support: (1) prompt diagnostic assessment of symptomatic women at all ages; (2) further population-based research on age-specific mammographic screening strategies to improve outcomes; (3) structured patient navigation programs to reduce diagnostic intervals; and (4) institutional protocols for time-to-treatment monitoring as a quality indicator. Future prospective studies with larger samples, audited source data, and cause-specific mortality data are warranted to confirm these findings.

AUTHORS' CONTRIBUTIONS

CFH: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. BDBB: Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest: nothing to declare.

Artificial Intelligence usage: none.

Data availability statement: The datasets generated and/or analyzed during the current study are not publicly available due to patient privacy and ethical restrictions. The are available from the corresponding author upon reasonable request and subject to ethical approval.

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