

Factors Associated with Standardized Diagnosis and Treatment of Breast Cancer: A Real-World Multicenter Study

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Objective: Breast cancer remains one of the leading causes of cancer-related death among women, and its incidence in Xinjiang is significantly higher than the national average. However, the extent to which breast cancer diagnosis and treatment are standardized in this region remains unclear, particularly with respect to key clinical decision-making processes such as surgical approach, pathological confirmation, and systemic treatment selection. This study aimed to identify factors associated with standardized breast cancer care within the Xinjiang Production and Construction Corps (XPCC).

Methods: A total of 670 patients who received their first breast cancer diagnosis at 11 XPCC hospitals between January 1, 2021, and January 1, 2022, were retrospectively included. Clinical and pathological variables were collected. According to the Chinese Anti-Cancer Association Guidelines for Breast Cancer (2021 Edition) and the AJCC Cancer Staging Manual (8th Edition), patients were classified into standardized and non-standardized care groups. Univariate and multivariate logistic regression analyses were performed to identify independent factors associated with standardized diagnosis and treatment.

Results: The median age at diagnosis was 53.27 years. The rate of standardized diagnosis was 76.12%. Multivariate analysis indicated that hospital location, ethnicity, and method of detection were independent predictors of standardized diagnosis ($P < 0.05$). Notably, low rates of preoperative core-needle biopsy and regional disparities in diagnostic capacity were observed. The rate of standardized treatment was 46.71%. Standardized diagnosis, hospital location, pathological type, and tumor stage were independently associated with standardized treatment ($P < 0.05$), with substantial variations in surgical modality selection, axillary management, neoadjuvant therapy use, and access to radiotherapy across hospitals.

Conclusion: The median age of breast cancer onset in the XPCC region is slightly younger than the national average. Significant disparities in standardized diagnosis and treatment exist between southern and northern Xinjiang, reflecting differences in healthcare infrastructure, availability of pathological testing, radiotherapy resources, and multidisciplinary decision-making capacity. Minority patients exhibited lower levels of disease awareness. These findings underscore the need to strengthen medical resources, optimize guideline-concordant clinical decision-making, and improve breast cancer management in this region.

Keywords: breast cancer, multicenter study, real-world study

Introduction

Breast cancer has become the most commonly diagnosed malignancy among women worldwide and remains the leading cause of cancer-related mortality, according to the latest GLOBOCAN estimates released by the International Agency for Research on Cancer (IARC).¹ Considerable geographic disparities in breast cancer incidence, stage at diagnosis, and survival outcomes have been reported, particularly between regions with differing levels of healthcare resources.^{2–6} These differences are often attributed to variations in screening accessibility, health awareness, socioeconomic development, and the availability of standardized diagnostic and treatment services.^{7,8}

In China, the incidence of breast cancer has shown a continuous upward trend, with the highest incidence observed among women aged 45–49 years.⁹ Lifestyle changes associated with rapid socioeconomic development, including reduced physical activity, increased obesity rates, and shortened breastfeeding duration, have further contributed to the rising disease burden.^{10–12} Notably, the Xinjiang region exhibits a significantly higher incidence of breast cancer than the national average.¹³ Previous studies

have demonstrated that ethnic minority women in Xinjiang present distinct clinicopathological characteristics and poorer survival outcomes compared with Han women, underscoring potential disparities in healthcare access and treatment quality.^{14,15}

Surgical management remains a cornerstone of breast cancer treatment. In Western countries, more than half of patients with early-stage breast cancer undergo breast-conserving surgery (BCS), whereas the rate of breast conservation in China has historically been much lower.¹⁶ Previous studies have reported that nearly 90% of early-stage breast cancer patients in China underwent mastectomy rather than BCS, although this proportion decreased to approximately 50% by 2015 and fluctuated between 51.1% and 54.5% until 2017.¹⁷ This discrepancy may be partly attributable to the limited availability of radiotherapy resources and a shortage of adequately trained radiation oncologists and technical staff. In addition, insufficient patient awareness of breast-conserving options, concerns regarding cosmetic outcomes, and fear of disease recurrence may further influence surgical decision-making.^{18–21} Compared with BCS, mastectomy may result in greater body image disturbance and psychological distress, thereby adversely affecting patients' quality of life.

In recent years, advances in multidisciplinary breast cancer management have led to the increasing use of neoadjuvant therapy.²² Neoadjuvant treatment can facilitate tumor downstaging, increase surgical resectability and breast conservation rates, and provide valuable information for subsequent therapeutic decision-making, thereby potentially improving patient prognosis.²³ However, challenges remain in accurately assessing treatment response, optimizing treatment selection and timing, and managing treatment-related adverse effects, highlighting the need for further investigation into the real-world implementation of standardized treatment strategies.²⁴

Despite these developments, limited evidence is available regarding the extent to which breast cancer diagnosis and treatment within the Xinjiang Production and Construction Corps (XPCC) adhere to established clinical guidelines. Given the unique multi-ethnic composition and variability in healthcare resources across XPCC hospitals, a comprehensive evaluation of standardized diagnostic and therapeutic practices is warranted.²⁵ Therefore, this multicenter, real-world study aimed to assess the current status of breast cancer diagnosis and treatment in XPCC hospitals and to identify key factors associated with standardized care, thereby providing evidence to inform targeted interventions and improve the overall quality of breast cancer management in this region.

Materials and Methods

Study Population

This multicenter, real-world retrospective study included breast cancer patients who received their first diagnosis between January 1, 2021, and January 1, 2022, at 11 hospitals within the Xinjiang Production and Construction Corps (XPCC). Hospitals in southern Xinjiang included the First, Second, and Third Division Hospitals, whereas hospitals in northern Xinjiang included the Fifth, Sixth, Seventh, Eighth, Ninth, Tenth, and Thirteenth Division Hospitals, as well as the First Affiliated Hospital of Shihezi University. A total of 670 patients met the inclusion criteria and were included in the final analysis. Across the 11 participating hospitals, the number of included patients per center ranged from 9 to 206.

Inclusion and Exclusion Criteria

The inclusion criteria were as follows: (1) female patients; (2) age ≥ 18 years; and (3) pathologically confirmed primary breast cancer.

The exclusion criteria included: (1) bilateral breast cancer; (2) a history of other malignant tumors; (3) non-primary breast cancer; and (4) insufficient clinical information that prevented assessment of standardized diagnosis and treatment.

Data Collection

Data were collected across three domains. General clinical characteristics included hospital location, age at diagnosis, marital status, ethnicity, medical history, smoking and alcohol consumption history, family history of breast cancer, and menopausal status. Tumor-related clinicopathological features included tumor laterality and quadrant, BI-RADS category at first detection, presence of symptoms, method of detection, tumor size, lymph node status, pathological type, clinical stage, Ki-67 expression, and immunohistochemical markers including estrogen receptor (ER), progesterone receptor (PR), and human epidermal growth factor receptor 2 (HER2). Treatment-related variables included whether a core-needle biopsy was performed before surgery, type of breast surgery and axillary lymph node surgery, use of neoadjuvant therapy,

**Table 1** Variable Assignment Notes

Variable	Coding Scheme
Hospital location	Southern Xinjiang = 1; Northern Xinjiang = 2
Marital status	Married = 1; Unmarried = 2
Ethnicity	Han = 1; Minority = 2
Medical history	No = 0; Yes = 1
Smoking history	No = 0; Yes = 1
Alcohol consumption	No = 0; Yes = 1
Family history of breast cancer	No = 0; Yes = 1
Menopausal status	Postmenopausal = 1; Premenopausal = 2
Method of detection	Hospital-detected = 0; Self-detected = 1
Diagnostic method	Surgical excision = 0; Core-needle biopsy = 1
Tumor laterality	Left = 1; Right = 2
Tumor quadrant	Upper outer = 1; Upper inner = 2; Lower inner = 3; Lower outer = 4
BI-RADS category at first detection	Category 4A = 1; Category 4B = 2; Category 4C or above = 3; Unknown = 4
Presence of symptoms	No = 0; Yes = 1
Tumor size	≤2 cm = 1; 2–5 cm = 2; >5 cm = 3
Lymph node status	No metastasis = 0; 0–10 nodes positive = 1; >10 nodes positive = 2; Unknown = 3
Pathological type	Invasive carcinoma = 1; Other types = 2
Clinical stage	Stage I = 1; Stage II = 2; Stage III–IV or unknown = 3
Ki-67 expression	>30% = 1; ≤30% = 2; Unknown = 3
ER/PR/HER2 status	Negative = 0; Positive = 1; Unknown = 2
Standardized diagnosis	Non-standardized = 0; Standardized = 1
Standardized treatment	Non-standardized = 0; Standardized = 1

Abbreviations: BI-RADS, Breast Imaging Reporting and Data System; ER, estrogen receptor; PR, progesterone receptor; HER2, human epidermal growth factor receptor 2.

and receipt of postoperative chemotherapy, endocrine therapy, targeted therapy, radiotherapy, or other treatments. Detailed variable definitions and coding schemes are summarized in [Table 1](#).

Definition of Standardized Diagnosis and Treatment

Standardized diagnosis was defined based on adherence to the AJCC Cancer Staging Manual (8th Edition), including complete clinical staging and documentation of molecular subtype classification. Cases lacking appropriate staging or molecular profiling were considered non-standardized. Reasons for non-standardized diagnosis were recorded.

Standardized treatment was defined according to the recommendations of the Chinese Anti-Cancer Association Guidelines for Breast Cancer (2021 Edition) and the NCCN Clinical Practice Guidelines in Oncology: Breast Cancer. Treatment plans were evaluated based on molecular subtype, pathological stage, and the presence of high-risk factors. Patients who received guideline-concordant therapy were classified into the standardized treatment group, whereas those who were undertreated or overtreated relative to guideline recommendations were assigned to the non-standardized group. Reasons for non-standardized treatment were also documented.

Statistical Analysis

Statistical analyses were performed using SPSS version 27.0. Categorical variables were presented as frequencies and percentages and compared using the chi-square test. Continuous variables following a normal distribution were expressed as mean ± standard deviation and compared using the independent-samples *t*-test. Skewed continuous variables were reported as median (interquartile range, IQR) and compared using the Wilcoxon rank-sum test. Univariate analysis and binary logistic regression models were used to identify factors associated with standardized diagnosis and treatment. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated. A two-tailed *P* < 0.05 was considered statistically significant.

Results

General Clinical Characteristics

A total of 670 patients aged 28–87 years were included, with a peak age distribution between 48 and 52 years. The mean age at diagnosis was 53.27 years (Figure 1). Most patients were from northern Xinjiang ($n = 558$, 83.28%). Individuals aged 43–62 years accounted for more than 70% of the study population. The majority were married ($n = 629$, 93.88%) and of Han ethnicity ($n = 602$, 89.85%). More than half of the patients had no prior medical history ($n = 376$, 56.12%), and only 5 patients (0.75%) reported a family history of breast cancer. Smoking and alcohol consumption were uncommon, reported by 9 (1.34%) and 13 patients (1.94%), respectively. Additionally, 396 patients (59.10%) were postmenopausal (Table 2).

Tumor Clinicopathological Characteristics

Tumor laterality was almost evenly distributed, with 334 (49.85%) tumors located in the left breast and 336 (50.15%) in the right breast. The upper outer quadrant was the most common tumor location ($n = 200$, 29.85%). At first detection, 342 patients (51.04%) were classified as BI-RADS 4B, and 121 (18.06%) as BI-RADS 4C or higher. More than half of the patients ($n = 349$, 52.09%) presented with symptoms at the time of diagnosis. Tumor size ranged from ≤ 2 cm in 267 patients (39.85%) to 2–5 cm in 344 patients (51.34%), whereas 59 patients (8.81%) had tumors > 5 cm. Most patients had no lymph node metastasis ($n = 460$, 68.66%), while 188 (28.06%) had 1–10 positive lymph nodes and 22 (3.28%) had > 10 positive nodes. The predominant pathological type was invasive carcinoma ($n = 614$, 91.64%). Stage II disease accounted for 370 cases (55.22%), followed by stage I ($n = 197$, 29.40%) and stage III–IV ($n = 56$, 8.36%); staging information was unknown in 47 patients (7.01%). Regarding proliferation and receptor status, 321 patients (47.91%) had a Ki-67 index $\leq 30\%$. ER, PR, and HER2 positivity were observed in 433 (64.63%), 343 (51.19%), and 162 (24.18%) patients, respectively (Table 3).

Treatment Patterns

Among the 670 patients, 582 (86.87%) underwent mastectomy, while 88 (13.13%) received breast-conserving surgery. For axillary management, 298 patients (44.48%) underwent sentinel lymph node biopsy alone, 178 (26.57%) received sentinel lymph node biopsy combined with axillary lymph node dissection, and 149 (22.24%) underwent axillary lymph node dissection alone; surgical details were unknown in 45 cases (6.72%). Preoperative core-needle biopsy was performed in 149 patients (22.24%), and 101 patients (15.07%) received neoadjuvant therapy. Postoperative

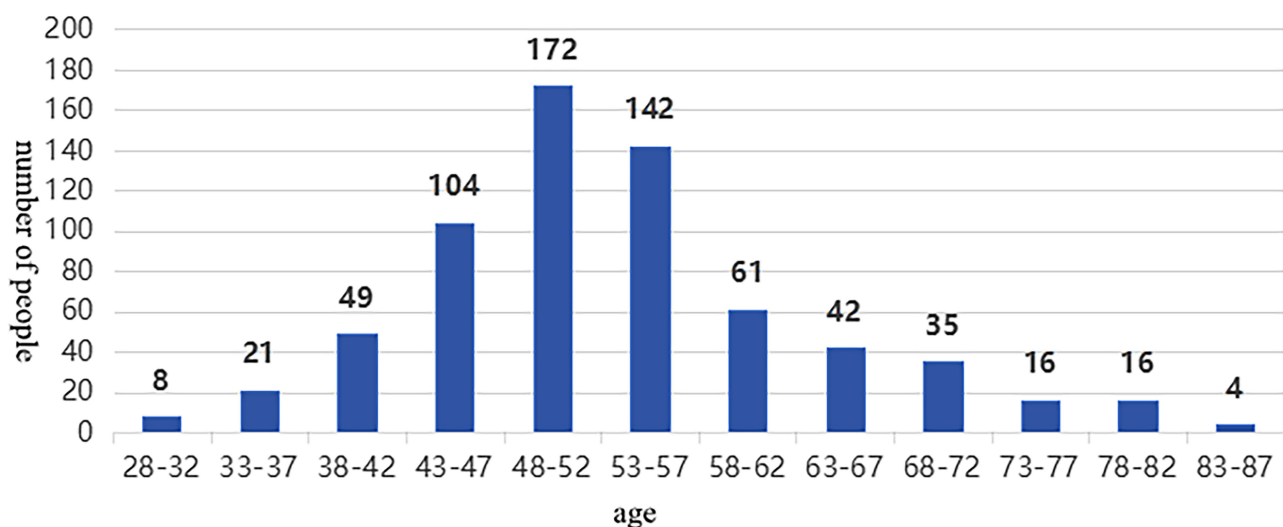


Figure 1 Distribution of breast cancer patients by age group in hospitals of some divisions and cities of Xinjiang Production and Construction Corps (2021–2022).



Table 2 Baseline Data on Breast Cancer in Hospitals of Some Divisions and Cities of Xinjiang Production and Construction Corps (2021–2022)

Variable	Category	Number of Cases (n)	Percentage (%)
Hospital location	Southern Xinjiang	112	16.72
	Northern Xinjiang	558	83.28
Age at diagnosis	<42 years	78	11.64
	43–52 years	276	41.19
	53–62 years	203	30.3
	63–72 years	77	11.49
	>72 years	36	5.37
Marital status	Married	629	93.88
	Unmarried	41	6.12
Ethnicity	Han	602	89.85
	Minority	68	10.15
Medical history	No	376	56.12
	Yes	294	43.88
Smoking history	No	661	98.66
	Yes	9	1.34
Alcohol consumption	No	657	98.06
	Yes	13	1.94
Family history of breast cancer	No	665	99.25
	Yes	5	0.75
Menopausal status	Postmenopausal	396	59.1
	Premenopausal	274	40.9
Diagnostic method	Surgical excision biopsy	521	77.76
	Core-needle biopsy	149	22.24
Method of detection	Hospital-detected	230	34.44
	Self-detected	440	65.67

Abbreviation: n, number of cases.

Table 3 Pathological Characteristics of Breast Cancer in Hospitals of Some Divisions and Cities of Xinjiang Production and Construction Corps from 2021 to 2022

Variable	Category	Number of Cases (n)	Percentage (%)
Tumor laterality	Left	334	49.85
	Right	336	50.15
Tumor quadrant	Upper outer quadrant	200	29.85
	Upper inner quadrant	160	23.88
	Lower inner quadrant	159	23.73
	Lower outer quadrant	151	22.54
	Unknown	20	2.99
BI-RADS category at first detection	Category 4A	187	27.91
	Category 4B	342	51.04
	Category 4C or above	121	18.06
	Unknown	20	2.99
Presence of symptoms	No	321	47.91
	Yes	349	52.09
Tumor size	≤2 cm	267	39.85
	2–5 cm	344	51.34
	>5 cm	59	8.81
Lymph node status	No lymph node metastasis	460	68.66
	1–10 positive lymph nodes	188	28.06
	>10 positive lymph nodes	22	3.28

(Continued)

Table 3 (Continued).

Variable	Category	Number of Cases (n)	Percentage (%)
Pathological type	Invasive carcinoma	614	91.64
	Other types	56	8.36
Clinical stage	Stage I	197	29.4
	Stage II	370	55.22
	Stage III–IV	56	8.36
	Unknown	47	7.01
Ki-67 expression	>30%	246	36.72
	≤30%	321	47.91
	Unknown	103	15.37
ER status	Negative	188	28.06
	Positive	433	64.63
	Unknown	49	7.31
PR status	Negative	278	41.49
	Positive	343	51.19
	Unknown	49	7.31
HER2 status	Negative	429	64.03
	Positive	162	24.18
	Unknown	79	11.79

Note: Categories are not mutually exclusive; individual patients may have more than one pathological characteristic of breast cancer.
Abbreviations: BI-RADS, Breast Imaging Reporting and Data System; ER, estrogen receptor; PR, progesterone receptor; HER2, human epidermal growth factor receptor 2.

chemotherapy and endocrine therapy were administered in 438 (65.37%) and 401 (59.85%) patients, respectively. In contrast, the proportions of patients receiving targeted therapy and radiotherapy were relatively low, at 143 (21.34%) and 140 (20.90%), respectively. A small number of patients ($n = 14$, 2.09%) received Uygur medicine, traditional Chinese medicine, or other alternative treatments (Table 4).

Table 4 Breast Cancer Treatment in Hospitals of Some Divisions and Cities of Xinjiang Production and Construction Corps from 2021 to 2022

Variable	Category	Number of Cases (n)	Percentage (%)
Surgical method	Mastectomy	582	86.87
	Breast-conserving surgery	88	13.13
Axillary lymph node surgery	Sentinel lymph node biopsy	298	44.48
	Sentinel lymph node biopsy + axillary lymph node dissection	178	26.57
	Axillary lymph node dissection	149	22.24
	Unknown	45	6.72
Preoperative core-needle biopsy	Yes	149	22.24
Neoadjuvant therapy	Yes	101	15.07
Postoperative chemotherapy	Yes	438	65.37
Postoperative endocrine therapy	Yes	401	59.85
Postoperative targeted therapy	Yes	143	21.34
Postoperative radiotherapy	Yes	140	20.9
Uygur medicine, traditional Chinese medicine, or other therapies	Yes	14	2.09

Note: Categories are not mutually exclusive; individual patients may have received more than one breast cancer treatment.
Abbreviation: n, number of cases.



Factors Associated with Standardized Diagnosis

Univariate Analysis of Factors Associated with Standardized Diagnosis

In the univariate analysis, hospital location, ethnicity, menopausal status, and method of detection were significantly associated with standardized diagnosis ($P < 0.05$), whereas marital status, medical history, smoking, alcohol consumption, family history, presence of symptoms, and diagnostic method showed no significant association ($P > 0.05$) (Table 5).

Multivariate Analysis of Factors Associated with Standardized Diagnosis

Variables with $P < 0.05$ in the univariate analysis were included in the multivariate logistic regression model. The results showed that hospital location, ethnicity, and method of detection were independent predictors of standardized diagnosis, while menopausal status was not ($P > 0.05$). Patients treated in southern Xinjiang had significantly lower odds of receiving standardized diagnosis compared with those in northern Xinjiang (OR = 0.290, 95% CI: 0.187–0.449). Han patients were more likely to receive standardized diagnosis than ethnic minority patients (OR = 1.771, 95% CI: 1.014–3.094). In addition, patients whose tumors were self-detected had higher odds of standardized diagnosis than those whose tumors were detected through hospital examination (hospital-detected vs self-detected: OR = 0.644, 95% CI: 0.440–0.942) (Table 6).

Factors Associated with Standardized Treatment

Univariate Analysis of Factors Associated with Standardized Treatment

Univariate analysis revealed that hospital location, ethnicity, menopausal status, diagnostic method, pathological type, clinical stage, ER status, PR status, HER2 status, HR+HER2– subtype, unknown subtype, and standardized diagnosis were significantly associated with standardized treatment ($P < 0.05$). In contrast, marital status, medical history, smoking, alcohol consumption, family history, method of detection, tumor laterality, tumor quadrant, BI-RADS category, tumor size, lymph node status, Ki-67 expression, and other molecular subtypes were not significantly associated with standardized treatment ($P > 0.05$) (Table 7).

Table 5 Single-Factor Analysis of the Diagnostic Specification Rate for Breast Cancer in Hospitals of Some Divisions and Cities of Xinjiang Production and Construction Corps from 2021 to 2022

Variable	Group	Non-Standardized (n)	Standardized (n)	Standardization Rate (%)	χ^2	P value
Hospital location	Southern Xinjiang	53	59	63.39	40.650*	<0.001
	Northern Xinjiang	107	451	83.69		
Marital status	Married	153	476	75.68	1.113	0.291
	Unmarried	7	34	82.93		
Ethnicity	Han	134	468	77.74	8.579*	0.003
	Minority	26	42	61.76		
Medical history	No	93	283	75.27	0.343	0.558
	Yes	67	227	77.21		
Smoking history	No	158	503	76.1	0.014	0.906
	Yes	2	7	77.78		
Alcohol consumption	No	155	502	76.41	1.551	0.213
	Yes	5	8	61.54		
Family history of breast cancer	No	159	506	76.09	0.042	0.838
	Yes	1	4	80		
Menopausal status	Postmenopausal	106	290	73.23	4.44	0.035
	Premenopausal	54	220	80.29		
Presence of symptoms	No	78	243	75.7	0.059	0.808
	Yes	82	267	76.5		
Method of detection	Hospital-detected	66	164	71.3	4.467	0.035
	Self-detected	94	346	78.64		
Diagnostic method	Surgical excision	120	401	76.97	0.927	0.336
	Core-needle biopsy	40	109	73.15		

Abbreviations: n, number of cases; χ^2 , chi-square value.

Table 6 Multivariate Analysis of the Diagnostic Specification Rate of Breast Cancer in Some Divisional Hospitals of Xinjiang Production and Construction Corps from 2021 to 2022

Variable	β	SE	Wald χ^2	P value	OR	95% CI (Lower–Upper)
Hospital location (reference: Northern Xinjiang)	0				1	
Southern Xinjiang	−1.239	0.224	30.668	<0.001	0.29	0.187–0.449
Ethnicity (reference: Minority)	0				1	
Han	0.572	0.285	4.037	0.045*	1.771	1.014–3.094
Menopausal status (reference: Premenopausal)	0				1	
Postmenopausal	−0.305	0.197	2.399	0.121	0.737	0.501–1.084
Method of detection (reference: Self-detected)	0				1	
Hospital-detected	−0.441	0.194	5.153	0.023	0.644	0.440–0.942
Constant	1.264	0.305	17.215	<0.001	3.538	—

Abbreviations: β , regression coefficient; SE, standard error; OR, odds ratio; CI, confidence interval; χ^2 , chi-square value.

Table 7 Univariate Analysis of the Treatment Compliance Rate for Breast Cancer in Hospitals of Some Divisions and Cities of Xinjiang Production and Construction Corps from 2021 to 2022

Variable	Group	Non-Standardized (n)	Standardized (n)	Standardization Rate (%)	χ^2	P value
Hospital location	Southern Xinjiang	92	20	17.86	44.995	<0.001
	Northern Xinjiang	265	293	52.51		
Marital status	Married	334	295	46.9	0.139	0.709
	Unmarried	23	18	43.9		
Ethnicity	Han	310	292	48.5	7.623	0.006
	Minority	47	21	30.88		
Medical history	No	190	186	49.47	2.606	0.106
	Yes	167	127	43.2		
Smoking history	No	351	310	46.9	0.656	0.418
	Yes	6	3	33.33		
Alcohol consumption	No	350	307	46.73	0.002	0.967
	Yes	7	6	46.15		
Family history of breast cancer	No	355	310	46.62	0.357	0.55
	Yes	2	3	60		
Menopausal status	Postmenopausal	226	170	42.93	5.579	0.018
	Premenopausal	131	143	52.19		
Diagnostic method	Surgical excision	261	260	49.9	9.563	0.002
	Core-needle biopsy	96	53	35.57		
Method of detection	Hospital-detected	130	100	43.48	1.475	0.225
	Self-detected	227	213	48.41		
Tumor laterality	Left	180	154	46.11	0.099	0.753
	Right	177	159	47.32		
Tumor quadrant	Upper outer quadrant	95	105	52.5	4.133	0.247
	Upper inner quadrant	92	68	42.5		
	Lower inner quadrant	87	72	45.28		
	Lower outer quadrant	83	68	45.03		
BI-RADS at first detection	Category 4A	95	92	49.2	2.036	0.565
	Category 4B	187	155	45.32		
	Category 4C or above	62	59	48.76		
	Unknown	13	7	35		
Presence of symptoms	No	165	156	48.6	0.877	0.349
	Yes	192	157	44.99		

(Continued)

**Table 7** (Continued).

Variable	Group	Non-Standardized (n)	Standardized (n)	Standardization Rate (%)	χ^2	P value
Tumor size	<2 cm	139	128	47.94	5.48	0.065
	2–5 cm	178	166	48.26		
	>5 cm	40	19	32.2		
Lymph node status	No lymph node metastasis	245	215	46.74	1.524	0.467
	1–10 positive lymph nodes	103	85	45.21		
	>10 positive lymph nodes	9	13	59.09		
Pathological type	Invasive carcinoma	320	294	47.88	4.014	0.045
	Other types	37	19	33.93		
Clinical stage	Stage I	110	87	44.16	59.097	<0.001
	Stage II	159	211	57.03		
	Stage III–IV or unknown	88	15	14.56		
Ki-67 expression	>30%	125	121	49.19	5.742	0.057
	≤30%	166	155	48.29		
	Unknown	66	37	35.92		
ER status	Negative	89	99	52.66	46.902	<0.001
	Positive	219	214	49.42		
	Unknown	49	0	0		
PR status	Negative	134	144	51.8	46.745	<0.001
	Positive	174	169	49.27		
	Unknown	49	0	0		
HER2 status	Negative	205	224	52.21	78.872	<0.001
	Positive	73	89	54.94		
	Unknown	79	0	0		
HR+/HER2–	No	195	141	41.96	6.115	0.013
	Yes	162	172	51.5		
HR–/HER2–	No	315	261	45.31	3.251	0.071
	Yes	42	52	55.32		
HR+/HER2+	No	319	268	45.66	2.141	0.143
	Yes	38	45	54.22		
HR–/HER2+	No	322	269	45.52	2.901	0.089
	Yes	35	44	55.7		
Unknown subtype	No	277	313	53.05	79.651	<0.001
	Yes	80	0	0		
Standardized diagnosis	Non-standardized	142	18	11.25	106.218	<0.001
	Standardized	215	295	57.84		

Abbreviations: n, number of cases; χ^2 , chi-square value; BI-RADS, Breast Imaging- Reporting and Data System; ER, estrogen receptor; PR, progesterone receptor; HER2, human epidermal growth factor receptor 2; HR, hormone receptor.

Multivariate Analysis of Factors Associated with Standardized Treatment

Variables with $P < 0.05$ in the univariate analysis were entered into a multivariate logistic regression model. Due to collinearity between ER, PR, and HER2 status and standardized diagnosis, only standardized diagnosis was included in the multivariable model. The results showed that standardized diagnosis, hospital location, pathological type, and clinical stage were independent factors associated with standardized treatment, whereas ethnicity and diagnostic method were not ($P > 0.05$). Patients with non-standardized diagnosis had markedly lower odds of receiving standardized treatment compared with those with standardized diagnosis (OR = 0.126, 95% CI: 0.073–0.218). Treatment standardization was

higher in northern Xinjiang than in southern Xinjiang (southern vs northern: OR = 0.276, 95% CI: 0.155–0.491). Compared with patients with stage III–IV or unknown stage, those with stage II and stage I disease were more likely to receive standardized treatment (OR = 2.089, 95% CI: 1.056–4.136; OR = 4.272, 95% CI: 2.234–8.169, respectively). In addition, patients with invasive carcinoma were more likely to receive standardized treatment than those with other pathological types (OR = 2.207, 95% CI: 1.168–4.170) (Table 8).

Discussion

Breast cancer incidence in China has continued to rise over recent decades, accompanied by a trend toward younger age at onset. National epidemiological data indicate that the median age at diagnosis is approximately 55 years, with the majority of cases occurring between 45 and 65 years.¹⁰ In the present study, patients from the Xinjiang Production and Construction Corps (XPCC) exhibited a slightly younger median age of 53.27 years. This finding suggests a potential earlier onset pattern among women in the XPCC compared with the national average, underscoring the need for region-specific prevention strategies and age-appropriate screening programs. Although breast-conserving surgery (BCS) has been increasingly adopted in China, the BCS rate in the XPCC remained low at 13.13% in this study. Notably, none of the participating hospitals had established breast oncoplastic or reconstructive surgery programs, which may substantially limit surgical options for patients. Compared with more developed mainland regions, this gap highlights considerable room for improvement in surgical capacity and the promotion of standardized breast-conserving approaches. In addition to institutional factors, patient-related considerations—including limited awareness of BCS, concerns regarding post-operative radiotherapy, and fear of recurrence—may also influence surgical decision-making.²⁶ Given that mastectomy may be associated with greater body image disturbance and psychological stress, the low uptake of BCS may have important implications for patients' quality of life. Similarly, the utilization rate of neoadjuvant therapy was relatively low (15.07%) in the XPCC cohort. Multiple factors may contribute to this pattern, including misconceptions regarding the safety or effectiveness of neoadjuvant treatment, concerns about delaying surgery, and limited access to timely medical information—particularly among ethnic minority populations. Cultural and language barriers may further influence treatment preferences, with some patients favoring immediate surgical intervention over systemic therapy. At the institutional level, the absence of well-established multidisciplinary team (MDT) frameworks in many hospitals may hinder standardized evaluation and implementation of neoadjuvant treatment. In addition, insurance coverage limitations and financial constraints may reduce patients' willingness or ability to receive recommended therapies.

Decisions regarding axillary surgery also reflect variability in real-world clinical practice. The choice between sentinel lymph node dissection (SLND) and axillary lymph node dissection (ALND) is often influenced by preoperative

Table 8 Multivariate Analysis of the Rate of Breast Cancer Treatment Compliance in Hospitals of Some Divisions and Cities of Xinjiang Production and Construction Corps from 2021 to 2022

Variable	β	SE	Wald χ^2	P value	OR	95% CI (Lower–Upper)
Standardized diagnosis (reference: Standardized)	0				1	
Non-standardized	−2.074	0.28	54.654	<0.001a	0.126	0.073–0.218
Hospital location (reference: Northern Xinjiang)	0				1	
Southern Xinjiang	−1.288	0.295	19.133	<0.001a	0.276	0.155–0.491
Ethnicity (reference: Minority)	0				1	
Han	0.264	0.326	0.658	0.417	1.303	0.688–2.467
Pathological type (reference: Other types)	0				1	
Invasive carcinoma	0.791	0.325	5.939	0.015a	2.207	1.168–4.170
Diagnostic method (reference: Core-needle biopsy)	0				1	
Surgical excision	0.337	0.229	2.166	0.141	1.4	0.894–2.193
Clinical stage (reference: Stage III–IV/Unknown)	0				1	
Stage II	0.737	0.348	4.474	0.034a	2.089	1.056–4.136
Stage I	1.452	0.331	19.278	<0.001a	4.272	2.234–8.169
Constant	−1.864	0.552	11.419	0.001a	0.155	—

Abbreviations: β , regression coefficient; SE, standard error; OR, odds ratio; CI, confidence interval; χ^2 , chi-square value.



imaging findings, surgeon experience, institutional protocols, and resource availability. In settings where standardized diagnostic workup or multidisciplinary discussion is limited, such variability may contribute to deviations from guideline-recommended axillary management. Notably, the standardization rate of breast cancer diagnosis in southern Xinjiang was significantly lower than that observed in northern Xinjiang. This disparity likely reflects differences in medical resources and diagnostic capacity. Missing immunohistochemistry results and incomplete staging documentation were more frequently observed in southern Xinjiang. Furthermore, some hospitals lacked fluorescence in situ hybridization (FISH) testing capabilities or relied on external tertiary centers for pathological review, leading to delays or incomplete molecular subtyping. As accurate and standardized diagnosis forms the foundation for appropriate treatment planning, these diagnostic deficiencies may result in downstream deviations from guideline-concordant therapy.

Multivariate analysis further identified hospital location, pathological type, and clinical stage as independent factors influencing treatment standardization. Patients with invasive carcinoma were more likely to receive guideline-based treatment than those with other pathological types, potentially because treatment pathways for invasive disease are more clearly defined and supported by stronger clinical evidence. In addition, patients diagnosed at earlier stages were more likely to receive standardized treatment, which may reflect both greater feasibility of guideline adherence and fewer treatment-related constraints. Conversely, reduced adherence among patients with advanced-stage disease may be attributable to physical frailty, increased financial burden, or heightened psychological stress. Several limitations of this study should be acknowledged. As a retrospective, multicenter analysis conducted within selected XPCC hospitals, the findings may not fully represent all institutions in the region. Socioeconomic factors—including income level, educational attainment, and insurance coverage—were not collected, although these variables are known to influence access to care and treatment adherence.^{27–29} In addition, the relatively short observation period precluded the evaluation of long-term oncological outcomes, such as disease-free survival and overall survival. These limitations should be considered when interpreting the results, and future prospective studies incorporating longer follow-up and broader socioeconomic data are warranted to further elucidate determinants of standardized breast cancer care. In conclusion, substantial regional disparities persist in the standardization of breast cancer diagnosis and treatment within the XPCC, particularly between northern and southern Xinjiang. Strengthening pathology services, expanding access to molecular diagnostic technologies, improving multidisciplinary collaboration, and enhancing patient education—especially among ethnic minority populations—are critical steps toward improving guideline-concordant care.^{30,31} Tailoring management strategies according to pathological subtype and disease stage, while providing additional support for patients with advanced disease, may further contribute to improving the overall quality of breast cancer management in this region.³²

Conclusion

This study demonstrates pronounced regional disparities in the standardization of breast cancer diagnosis and treatment within the Xinjiang Production and Construction Corps, with substantially lower adherence observed in southern Xinjiang. Standardized diagnosis emerged as the most important determinant of guideline-concordant treatment, while hospital location, pathological type, and clinical stage were also independently associated with treatment adherence. These findings highlight the critical role of diagnostic capacity in shaping downstream treatment decisions. Strengthening pathology services, expanding multidisciplinary collaboration, and improving patient education—particularly among ethnic minority populations—are essential steps toward enhancing the consistency and quality of breast cancer care across the region.

Study Limitations

Several limitations of this study should be acknowledged. Although data were collected from multiple hospitals within the Xinjiang Production and Construction Corps, the participating institutions may not fully represent all healthcare settings in the region. As a retrospective analysis, the study depended on the completeness and accuracy of medical records, and incomplete pathological or molecular information may have affected the evaluation of diagnostic standardization. In addition, socioeconomic variables, such as income level, educational attainment, and insurance coverage, were not available for analysis, despite their potential influence on treatment decision-making and adherence. Finally, the absence of long-term follow-up data precluded assessment of oncological outcomes, limiting conclusions regarding the

clinical impact of non-standardized diagnosis and treatment. Future prospective studies with extended follow-up and more comprehensive data collection are warranted to further clarify determinants of standardized breast cancer care in this region.

Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Ethics Approval and Informed Consent

This study was approved by the Research Ethics Committee of the First Affiliated Hospital of Shihezi University (Approval No.: KJ2023-546-01). Written informed consent was obtained from all participants prior to study commencement. We state that our study complies with the Declaration of Helsinki.

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Disclosure

The authors declare that there is no conflicts of interest in this work.

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