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# The current diagnosis and treatment strategy of breast cancer based on multicentre retrospective data in Shaanxi province

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## Abstract

**Background** Breast cancer is a common malignancy, and early detection coupled with standardized treatment is crucial for patient survival and recovery. This study aims to scrutinize the current state of breast cancer diagnosis and treatment in Shaanxi province, providing valuable insights into the local practices and outcomes.

**Methods** We selected 25 hospitals that typically represent the current diagnosis and treatment strategy of breast cancer in Shaanxi (a province in northwest China). The questionnaire comprised sections on fundamental information, outpatient consultations, breast-conserving surgery, neoadjuvant and adjuvant therapy, sentinel lymph node biopsy, breast reconstruction surgery.

**Results** A total of 6665 breast cancer operations were performed in these 25 hospitals in 2021. The overall proportion of breast-conserving surgery (BCS) is 23.6%. There was a statistically significant positive correlation between the annual volume of breast cancer surgery and the implementation rate of BCS ( $P=0.004$ ). A total of 2882 cases of neoadjuvant treatment accounted for 43.24% of breast cancer patients treated with surgery in 2017. Hospitals in Xi'an performed more neoadjuvant therapy for patients with breast cancer compared to other districts ( $P=0.008$ ). There was a significantly positive correlation between outpatient visits and the implementation rate of sentinel lymph node biopsy (SLNB) ( $P=0.005$ ). 14 hospitals in Shaanxi performed reconstructive surgery.

**Conclusions** Breast conserving surgery, adjuvant and neoadjuvant therapy and sentinel lymph node biopsy in Shaanxi province have reached the China's average level. Moreover, hospitals in Xi'an have surpassed this average. However, a disparity is observed in the development of breast reconstruction surgery when compared to top-tier hospitals.

**Keywords** Breast cancer, Diagnosis and treatment, Questionnaire survey

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## Introduction

The incidence of breast cancer is increasing year by year, female breast cancer has exceeded lung cancer as the most commonly diagnosed cancer [1]. However, mortality rates were varied widely in Oceania, the Americas, and Asia [2].

In America, between 1989 and 2020, there was a significant decrease of 43% in breast cancer mortality rates, corresponding to 460,000 fewer breast cancer deaths, primarily attributed to advancements in early detection through screening and improvements in treatment [3, 4]. In contrast, the trend in China shows a gradual increase in breast cancer mortality from 2000 to 2016. The 5-year survival rate for breast cancer in China is 82.0%, which is notably lower than the 90.9% 5-year survival rate seen in developed countries like the United States. This disparity can be attributed to several factors, including a low number of early clinical visits, delays in diagnosis, and suboptimal clinical management of advanced cases [5].

Therefore, it is important to understand the current status of breast cancer diagnosis and treatment in China. Diagnosis and treatment in China differed from those in developed countries, and also from one part of China to another. While some studies have reported the variations in breast cancer diagnosis and treatment across different parts of China [6–9], there is still a lack of research specifically investigating the diagnosis and treatment status in Shaanxi (a province in northwest China, detailed information in Additional File 1) which represents a moderate level of healthcare in China. Consequently, in this study, we present the situation of breast cancer diagnosis and treatment in Shaanxi by conducting a questionnaire survey in representative medical institutions. Furthermore, the study aims to evaluate the implementation of guidelines in different areas, with the goal of promoting adherence to these guidelines and encouraging communication and collaboration among different districts.

## Methods

### Hospitals and survey methods

In this study, we selected 25 centres from all centres in Shaanxi, which are considered representative samples for the issue under investigation. However, due to regional medical level and other constraints, five hospitals were unable to complete all the questions. The questionnaire was sent as a message, and the local department in charge obtained all the information according to the hospital's medical information system. To ensure the authenticity and validity of the data, the individuals responsible for completing the questionnaire were all physicians at the deputy director level or above. All methods utilized in this study were conducted in strict adherence to the relevant guidelines and regulations.

### Design of questionnaire

The questionnaire was designed by Dr. Liu. The questionnaire consisted of the following 3 sections with 58 items (detailed in Additional File 2). The first section collected information about the participating hospital. The second section is for outpatient diagnosis and treatment. The third section covers the treatment of inpatients, including breast-conserving surgery, neoadjuvant therapy, sentinel lymph node biopsy, breast reconstruction surgery, and adjuvant therapy. All responses were subsequently compiled and analyzed.

### Statistical analysis

The frequency and proportions of all collected variables were calculated using statistical software SPSS 25.0. The data were analyzed using Fisher's exact test, Kruskal-Wallis rank-sum test, Wilcoxon rank-sum test, and the results are presented descriptively in figures and tables. All tests were considered statistically significant at  $p < 0.05$ .

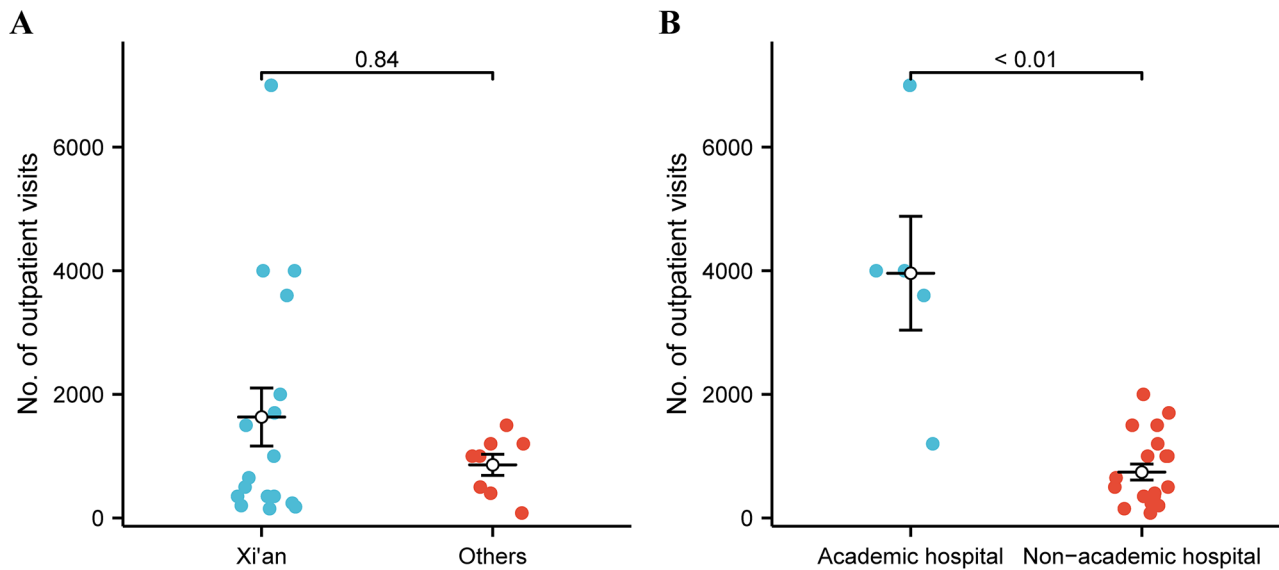
## Results

### Hospital general information

Of the 25 hospitals, 92% (23/25) were 3 A hospitals, the highest level in the Chinese healthcare system, 20% (5/25) were academic hospitals and 4% (1/25) were cancer hospitals. 56% (14/25) hospitals set up specialist breast clinics, which accounted for more than half of outpatient visits (81%) in Shaanxi. Of the 25 hospitals, 9 hospitals with more than 10 breast specialists accounted for 76.75% of outpatient visits, 8 of which were in Xi'an. A total of 6665 breast cancer operations were performed in these 25 hospitals in 2021. Of these, 40% of the centres (10/25) performed fewer than 100 breast cancer operations, and 16% of the centres (4/25) performed more than 1000 operations, all of which were only in Xi'an. According to AGCC TNM staging, 22.26%, 47.70%, 21.27% and 8.77% of breast cancer patients were in stage I, stage II, stage III and stage IV.

We found that there was no significant correlation between the monthly outpatient visit numbers and the hospital district, whereas there was a statistically significant correlation with the status of the hospital as an academic institution ( $P=0.002$ ). (Figure.1). More outpatient visits were shown in Xi'an and academic hospitals. Most hospitals (56%) had more than 500 outpatient visits per month, and 4 hospitals had more than 3,000, all of which were academic hospitals.

In terms of outpatient examination methods, ultrasound and mammography were the most commonly used diagnostic techniques. Breast ultrasound was used in over 80% of outpatient examinations in 92% of hospitals.



**Fig. 1** The influence of monthly outpatient visit numbers

**Table 1** The influence of the implementaton of BCS

Items	Area		Academic hospital		The volume of annual breast cancer surgeries	
	Xi'an	Others	Yes	No	≥ 100	< 100
The rate of BCS (%)	20.9	11.3	23.0	16.5	24.2	9.6
Statistic	Z=-1.508		Z=-1.627		Z=-2.892	
P	0.104		0.290		0.004	

**Table 2** The influence of the implementaton of SLNB in patients with cN0 breast cancer

The proportion of cN0 patients who received SLNB	No. of hospitals	Area		The volume of outpatient visits		The volume of annual breast cancer surgeries	
		Xi'an	Others	≥ 500	< 500	≥ 100	< 100
0-50%	10	5	5	2	8	3	9
51-100%	15	12	3	12	3	9	6
P		0.194	0.005	0.226			

**Breast-conserving surgery**

A total of 1574 breast-conserving surgeries (BCS) were performed in these hospitals in 2021. The overall rate of breast-conserving surgery for operable breast cancer in Shaanxi was 23.62%. 13 hospitals reported breast-conserving surgery rates of less than 20%, of which 12 hospitals had rates of less than 10%.

We analyzed the influences on the implementation of BCS. There was a statistically significant positive correlation between the annual volume of breast cancer surgery and the implementation rate of BCS ( $P=0.004$ , Table 1). The proportion of BCS varied across hospitals in different districts and with different characteristics. Although Xi'an reported higher rates of BCS compared to other districts, the difference was not statistically significant ( $P>0.05$ ). Additionally, there was no statistically significant difference in the percentage of BCS between

academic and non-academic hospitals ( $P>0.05$ ). The rate of BCS implementation after neoadjuvant chemotherapy was low, with less than 20% of cases undergoing the procedure in 76% of hospitals.

Regarding tumor resection, 60% of hospitals chose a width of 2 cm for the incision margin.

**Sentinel Lymph Node Biopsy**

All 25 hospitals performed sentinel lymph node biopsy (SLNB). Among these, 60% (15/25) hospitals routinely performed axillary SLNB for over 50% of patients with cN0 disease, and 4 hospitals performed it for less than 10% of patients. We analyzed the influences on the implementation of SLNB. There was a significantly positive correlation between outpatient visits and the implementation rate of SLNB ( $P=0.005$ , Table 2). A higher

**Table 3** The influence of implementation of breast reconstruction

	No. of hospitals	The implementation of BR	
		Yes	No
<b>Area</b>			
Xi'an	17	12	5
Others	8	2	6
<i>P</i>		0.081	
<b>No. of Breast Surgeons</b>			
< 10	16	6	10
≥ 10	9	8	1
<i>P</i>		0.033	
<b>Academic hospital</b>			
Yes	5	5	0
No	20	9	11
<i>P</i>		0.046	
<b>The volume of annual breast cancer surgeries</b>			
< 100	13	4	9
≥ 100	12	10	2
<i>P</i>		0.015	

proportion of SLNB was performed in Xi'an, but the difference was not statistically significant (Table 2).

Most of hospitals (18/25) used methylene blue (a type of blue dye) alone for SLNB in breast cancer in all 25 hospitals, while the remaining hospitals opted for the use of nano-carbon as the tracer. In our survey, we did not find any hospitals reporting the use of radiopharmaceuticals.

All hospitals used intraoperative frozen section to identify malignant cells within axillary lymph nodes. Among the 25 hospitals, 20% (5/25) of the hospitals, omitted axillary lymph node dissection (ALND) in over 50% of patients with cN0 disease or those with 1–2 metastatic SLNs who underwent BCS. However, most hospitals preferred to perform ALND in these patients. In contrast, only 8% (2/25) of the hospitals accepted omitting ALND for patients above 50% during mastectomy. Given that all hospitals are cautious about these patients, whether such patients are omitted from ALND is not related to the character of the hospital, the region, or the volume of surgery.

**Breast Reconstruction surgery**

A total of 14 hospitals in Shaanxi province conducted reconstructive surgery (BR). Among the 6 hospitals that treat more than 200 cases of breast cancer patients annually, 100% of them have already performed breast reconstruction surgery, the BR after mastectomy was more than 10%. We analyzed the influences on the implementation of BR. There was a statistically significant difference in the volume of breast surgery, academic hospitals and number of breast surgeons associated with whether

**Table 4** The influence of breast reconstruction in hospitals that performed breast reconstruction

	No. of hospitals	The proportion of BR (%)
<b>Area</b>		
Xi'an	11	17.4 (16.3–18.6)
Others	3	5 (2.1–7.9)
<i>P</i>		< 0.000
<b>No. of Breast Surgeons</b>		
< 10	6	6.8(3.3–10.3)
≥ 10	8	17.2 (16.1–18.4)
<i>P</i>		< 0.000
<b>Academic hospital</b>		
Yes	5	21.2(19.8–22.7)
No	9	7.8(6.4–9.1)
<i>P</i>		< 0.000
<b>The volume of annual breast cancer surgeries</b>		
< 100	8	8.7(6.1–11.4)
≥ 100	6	17.6(16.5–18.8)
<i>P</i>		< 0.000

the hospital performed reconstructive surgery. (*P*=0.015, *P*=0.046, *P*=0.033, Table 3).

A total of 645 (83.4%) cases of implant breast reconstruction and 128 (16.6%) cases of autologous breast reconstruction were performed in Shaanxi in 2021. Within this, the use of implant BR alone accounted for more than 80% in 7 hospitals. There was a statistically significant difference in the volume of breast surgery, academic status of hospitals, and number of breast surgeons, which influenced the decision to perform breast reconstruction surgery. (*P*<0.001, Table 4).

For the timing of breast reconstruction, only 2 hospitals chose immediate breast reconstruction for 31–50%, while others chose less than 30%. 1 hospital chose delayed surgery for more than 30%. In all cases, the failure rate for breast reconstruction is less than 5%.

Since 3 hospitals did not face the following conditions, the following is an analysis of the data from 11 hospitals.

For patients clearly requiring postoperative radiotherapy, most hospitals (72.7%) opted for delay-immediate breast reconstruction. 90.9% of hospitals preferred to replace the prosthesis at 6 months after radiotherapy.

**Neoadjuvant therapy**

All 25 hospitals had performed neoadjuvant therapy. In 2021, a total of 2882 cases of neoadjuvant therapy were performed, accounting for 43.24% of breast cancer patients who underwent surgery. Hospitals in Xi'an administered neoadjuvant therapy to more patients compared to hospitals in other districts (*P*=0.008, Table 5).

For stage III patients, the majority of hospitals (13) reported neoadjuvant chemotherapy rates exceeding 70% in Xi'an. Moreover, 7 hospitals had a positive

**Table 5** The stage of patients who received neoadjuvant chemotherapy

Item	No. of hospitals	The proportion of patients who received neoadjuvant chemotherapy				The proportion of patients who received neoadjuvant chemotherapy (Stage II)			The proportion of patients who received neoadjuvant chemotherapy (Stage III)		
		0–20%	21–40%	41–60%	61–80%	0–10%	11–30%	31–50%	30–50%	51–70%	>70%
Xi'an	17	7	5	3	2	5	6	6	3	1	13
Others	8	6	2	0	0	6	1	1	6	1	1
Statistic		Z=-2.657	—	—	—	—	—	—			
P		0.008	—	—	—	—	—	—			

**Table 6** The clinical decision in adjuvant therapy

Clinical decision	No. of hospitals	
	Xi'an	Others
<b>Preferred regimen for ER<sup>-</sup>HER2<sup>+</sup> patients (with targeted therapy)</b>		
Anthracycline with taxane	0	0
Anthracycline followed by taxane	12	1
Anthracycline without taxane	0	0
Taxane with other drugs	4	1
<b>Preferred regimen for TNBC</b>		
Anthracycline with taxane	0	0
Anthracycline followed by taxane	13	1
Anthracycline without taxane	2	1
Platinum-containing regimen	1	0
<b>Proportion of OFS (%)</b>		
0–20	2	0
21–40	5	1
41–60	3	0
61–80	6	1
<b>Recommended endocrine therapy length for patients with intermediate risk t/year</b>		
5	4	1
10	12	1
>10	0	0

attitude towards neoadjuvant therapy for stage II patients (Table 5). This indicates a higher concentration and more aggressive treatment approach for advanced breast cancer in Xi'an compared to other regions.

**Adjuvant therapy**

Since 7 hospitals did not face the following conditions, the following is an analysis of the data from 18 hospitals (Table 6).

For the preferred chemotherapy regimen for ER<sup>-</sup>HER2<sup>+</sup> (estrogen receptor-negative/human epidermal growth factor receptor 2-positive) (combined with anti-HER2), 13 hospitals chose anthracycline followed by taxane, and 5 chose taxanes in combination with other drugs.

For triple-negative breast cancer (TNBC) patients, 14 hospitals chose anthracycline followed by taxane, 3 hospitals preferred anthracycline with taxane, and only 1 hospital used a platinum-containing regimen.

Most hospitals used OFS (ovarian function suppression) accounting for 61–80% of all premenopausal patients. In contrast, only 2 hospitals used it for less than 20% of premenopausal patients.

5 (27.8%) hospitals recommended 5 years of endocrine therapy for middle-risk patients, and 13 recommended an extension to 10 years.

**Discussion**

The annual mortality rate from breast cancer stands at approximately 71,700, ranking it fifth among female tumor-related deaths. From 1989 to 2020, 460,000 breast cancer deaths were avoided among women in the United States, and the decrease in mortality is attributed to better, more targeted treatment and early detection through mammography screening [4]. In China, major cities like Beijing and Shanghai with specialized hospitals offer better standardized care, resulting in a five-year survival rate comparable to Western countries. However, there is a stark contrast in the five-year survival rates between big cities and smaller cities, towns, and rural areas. This difference may be due to the relative weakness in standardization in these regions. However, reports of comprehensive medical practice surveys of hospitals in all regions of the country are still unavailable, especially in the Northwest. In our study, we found that the central hospital in Xi'an absorbs more breast cancer patients. Meanwhile, its level of diagnosis and treatment is more advanced than the surrounding areas in Shaanxi. There was a trend towards centralization and specialization in diagnosing and treating breast diseases.

In this study, we found that more than 60% of patients with breast cancer were diagnosed at stages I and II. This proportion is lower compared to western countries where more than 70% of patients are diagnosed at these early stages, and it can even exceed 80% [10, 11]. In contrast, in developing countries only 20–60% of patients are diagnosed at earlier stages, while a higher percentage, ranging from 30 to 80%, are diagnosed at stages III and IV [11]. According to some studies in China [12–14] have also shown that between 60 and 70% of the patients are diagnosed in stage I and II. However, the 5-year survival rate for Chinese women with breast cancer from 2010 to 2014 was only 83.2% [15]. In contrast, the 5-year relative

survival for patients diagnosed during 2012–2018 in the Americas was above 99% for stage I disease, 93% for stage II, 75% for stage III, and 29% for stage IV [4]. The proportion of early-stage breast cancer and the 5-year relative survival in China are both below those in developed countries. Early detection of cancer has been shown to greatly reduce breast cancer mortality rates in the long term [16]. Therefore, health education and intervention activities should be conducted to actively promote the importance of screening for breast cancers among young patients.

For outpatient visits, people tend to choose academic hospitals. This preference can be attributed to the fact that academic hospitals have specialized clinics, more specialized doctors, and better medical expertise. In outpatient examinations, breast ultrasound is more commonly used than mammography. This is likely due to the characteristics of Chinese women's breasts, patient acceptance, and promotional efforts. Chinese women generally have smaller and denser breasts compared to white women [17]. Ultrasound is a proper method for screening women with dense breasts [18]. Moreover, the non-radiation and non-painful nature of ultrasound makes it more acceptable to patients. Compared with patients with breast cancer in Europe and the United States, Chinese patients have distinct features, we need more evidence to suppose the strategies of screening for Chinese women.

The survey results indicate that Shaanxi has achieved or even surpassed the national average level in breast-conserving surgery, neoadjuvant and adjuvant therapy, and sentinel lymph node biopsy, as demonstrated by some multicenter studies [6, 7, 9, 19]. We hypothesize that these advancements may be associated with the evolution of breast cancer treatment concepts, the implementation of standardized guidelines, the circulating reports from the Breast Cancer Special Committee, the proactive engagement of academic teams and the change in health care policy. Additionally, easy access to international sources for communication, information exchange at different stages, and the adoption of cutting-edge technology could also contribute to these improvements. However, there are still disparities in the data regarding treatments between different countries.

Numerous clinical trials and meta-analyses [20–25] have confirmed that breast conserving therapy (BCT) and mastectomy have similar survival outcomes. However, our survey showed that the breast conservation rate in Shaanxi is 23.3%, reaching the national average [9], which is still different from that of foreign countries (America: 60%, Europe: 80%) [26, 27]. We suggest that this is related to the late diagnosis of breast cancer patients in China (Shaanxi) and the uneven level of patient awareness and treatment. Patients in China are relatively conservative

in their choice of breast conservation surgery was related to fear of recurrence, avoidance of further treatment and belief in an overall healthy image [28–30]. Meanwhile, the choice of BCT is also associated with the hospital providers [28]. Training techniques and surgeon specialization allow physicians to offer women personalized treatment options [31]. Our survey indicates that doctors favor 2 cm margins. In China, intraoperative frozen section analysis is common for breast-conserving surgery. Many hospitals use selective sampling of the nipple, medial, lateral, and distal sections, or suspicious areas identified by the surgeon. This method offers minimal tissue sampling and quick results but may miss some margin statuses. Therefore, doctors prefer wider margins and multi-point intraoperative sampling with pathological examination to ensure negative margins, enhancing surgical safety and patient outcomes. However, as awareness of breast-conserving surgery and the desire for better cosmetic results grow, the trend is shifting towards smaller surgical margins.

According to our survey, 60% (15/25) hospitals routinely performed axillary SLNB for more than 50% of patients with cN0 disease. Larger hospitals commonly conduct SLNB for cN0 patients, akin to the findings of a 2017 cross-sectional study in China [6]. However, the implementation of SLNB in smaller hospitals and non-metropolitan areas still faces challenges. However, it is not widely used compared to in developed countries (China:43.4% [32], Dutch: 93% [33], United States: 91.4% [34]).

Despite substantial high-quality evidence and authoritative guidelines supporting the omission of ALND, most surgeons in China, regardless of hospital type, region, remain cautious about omitting ALND in patients with low axillary SLN burden. This is likely due to the lower rate of breast-conserving surgery and pathologic modalities. This differs from the decreasing trend of ALND rate observed in foreign countries [35]. In the ACSOG Z0011 study [36], which included patients undergoing breast-conserving surgery with 1–2 positive sentinel nodes, the 10-year overall survival (OS) and disease-free survival (DFS) between the SLNB-only and ALND group showed no significant difference. Similarly, in the AMAROS trial and the OTOASOR trial [37, 38], involving patients with sentinel node metastases, individuals were randomized to receive either ALND or axillary radiotherapy. After 10 and 8 years of follow-up respectively, no difference was observed in axillary recurrence or survival. The St. Gallen Consensus Guidelines recommend that ALND can be exempted for patients treated by breast-conserving surgery and radiotherapy, or mastectomy and axillary radiotherapy, with 1–2 positive SLN [39]. The 2024 edition of the Breast Cancer Diagnosis and Treatment Guidelines by the China Anti-Cancer Association also recommends that for patients with 1–2 positive SLNs,

axillary lymph node dissection (ALND) can be conditionally and safely replaced [40]. The latest conclusions from the SENOMAC study further confirm that for clinically node-negative T1 to T3 breast cancer patients with 1–2 positive sentinel nodes, either undergoing breast-conserving surgery or mastectomy, most of whom receive nodal radiotherapy, the five-year disease-free survival rate is similar between SLNB-only and ALND group [41]. Given the existing medical landscape and guidelines, it is crucial for China to explore its own path in addressing axillary lymph node dissection.

Our survey also demonstrated that, compared to another multicenter study in China [8], a smaller percentage of hospitals in Shaanxi conducted breast reconstruction compared to hospitals nationwide (56% vs. 87.3%). The observed discrepancy in the adoption of breast reconstruction surgery in Shaanxi province, compared to the more developed north-eastern region, may be partly attributed to the limited economic development in the region. Patients in Shaanxi tend to have lower awareness and willingness to undergo breast reconstruction surgery. Additionally, hospitals in the area started offering this procedure later, and there is a scarcity of breast surgeons with plastic surgery expertise. These factors contribute to the slower adoption of breast reconstruction surgery in Shaanxi. Furthermore, fewer hospitals in Shaanxi province performed autologous breast reconstruction compared to the national average, which might be associated with the longer learning curve and patient recovery times for this technique. There is also a notable polarization in breast reconstruction awareness and rates within Shaanxi. Breast reconstruction is more frequently performed in Xi'an compared to other parts of the province. While a limited number of other regions also offer breast reconstruction surgery, they often rely on guidance from hospitals in the Xi'an area. The lower availability of breast reconstruction surgery in surrounding areas may be due to hospital limitations and doctors' safety concerns. As a result, it is essential to actively promote training and breast reconstruction to address these disparities.

This study provides a comprehensive reflection of the current status of breast cancer diagnosis and treatment in Shaanxi, and includes outpatient treatment information. Aim to promote standardized diagnosis and treatment of breast cancer, and explore treatment strategies suitable for the Chinese region to improve the survival quality of patients.

There are some limitations in this study. Firstly, the 25 hospitals surveyed in this study are mainly 3 A hospitals, and there is a lack of data from grassroots hospitals, which may result in an overestimation of the overall healthcare level in Shaanxi. Additionally, the study did not investigate the survival rates of breast cancer or the prevalence of promising surgical techniques such as laparoscopic surgery. Moreover, the study only provided a general assessment of

diagnosis and treatment, without investigating controversial topics in various fields.

## Conclusions

In conclusion, this report outlines the current diagnosis and treatment of breast cancer in Shaanxi province. It was found that the central hospital in Xi'an receives a higher number of breast cancer patients and provides more advanced diagnosis and treatment compared to the surrounding areas in Shaanxi. Although Shaanxi has achieved or even surpassed the national average level in breast-conserving surgery, neoadjuvant and adjuvant therapy, and sentinel lymph node biopsy, a smaller percentage of hospitals in Shaanxi performed breast reconstruction compared to hospitals nationwide.

## Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12957-024-03485-4>.

Supplementary Material 1

Supplementary Material 2

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## Author contributions

(I) Conception and design: QD and DL. (II) Administrative support: SZ, DL. (III) Provision of study materials or patients: QD, YG, YZ, JQ, YG. (IV) Collection and assembly of data: QD, YG, YZ, JQ(V) Data analysis and interpretation: QD, YG, YZ, JQ, YG. (VI) Manuscript writing: All authors. (VII) Final approval of manuscript: All authors.

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## Data availability

No datasets were generated or analysed during the current study.

## Declarations

### Ethical approval

This study is registry-based without any active involvement of patients and was conducted in full respect of clinical practice regulation. Patients' data of this retrospective study were completely anonymized before analysis. The study was approved by the General Director of the Hospital involved. The need for ethics approval was waived by the Second Affiliated Hospital of Xi'an Jiaotong University Ethics Committee and written informed consent was given by all participants. We affirm that all methods employed in this study were performed in accordance with the relevant guidelines and regulations.

### Competing interests

The authors declare no competing interests.

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