



Fertility preservation in young breast cancer patients: A nationwide survey on knowledge, attitudes, and practices among breast surgical healthcare providers in China

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ABSTRACT

Purpose: Fertility preservation (FP) is a critical concern for young breast cancer (YBC) patients receiving gonadotoxic treatments. Breast surgical healthcare providers (HCPs) play a pivotal role in discussing FP options and facilitating timely referrals. This study aimed to assess the knowledge, attitudes, and practices of breast surgical HCPs in China regarding FP, identify barriers to FP discussions, and examine factors influencing referral practices.

Methods: A nationwide cross-sectional survey was conducted from March to June 2023 among board-certified breast surgeons and nurses across China using a 24-item questionnaire. Participants were recruited via WeChat through BestOnco, a professional platform for oncology HCPs. The survey assessed FP knowledge, attitudes, clinical practices, and perceived barriers. Multivariate logistic regression was performed to determine factors associated with FP referral practices.

Results: A total of 355 valid responses were analyzed. The mean FP knowledge score was 6.05 ± 1.94 (range 0–10), with 49.3 % of HCPs never consulting FP guidelines. While 82.8 % expressed a favorable attitude toward FP, only 42.3 % routinely discussed FP options, and 44.7 % referred patients to reproductive specialists. Major barriers included poor prognosis concerns (87.0 %), treatment urgency (67.9 %), and financial burden (60.0 %). Multivariate analysis revealed that higher FP knowledge ($OR = 1.23, p < 0.0001$), longer clinical experience ($OR = 2.93, p = 0.001$), and hospital-based FP integration ($OR = 1.83, p < 0.0001$) were significant predictors of referral.

Conclusions: Notable gaps were identified in FP knowledge, discussions, and referrals among breast surgical HCPs in China. Targeted FP training programs, culturally informed shared decision-making strategies, and oncofertility navigation systems are recommended to enhance FP service delivery and improve patient outcomes.

1. Introduction

Breast cancer remains the most prevalent malignancy among women worldwide. Advances in early detection and treatment have significantly improved survival rates, yet fertility concerns remain a critical issue, particularly for young patients. As more women delay childbearing,

nearly half of young breast cancer patients (YBC) have not completed their families at diagnosis [1]. Research has indicated that 50%–89 % of women diagnosed with breast cancer still desire future fertility [2,3]. However, fertility outcomes are often compromised by cancer treatment. The pregnancy rate among survivors is only 3 %, approximately 40 % lower than in the general population.

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Chemotherapy, especially alkylating agents, is well-documented to induce amenorrhea and premature ovarian failure [4,5]. For patients with endocrine-responsive YBC, endocrine therapy further delays conception for at least five years, exacerbating fertility decline due to natural ovarian aging [6]. Consequently, infertility emerges as a major concern for young survivors, ranking second only to fear of cancer recurrence [7–9], and significantly affecting their quality of life [10,11].

Advancements in assisted reproductive technologies offer potential solutions, with embryo, oocyte, and ovarian tissue cryopreservation now considered standard fertility preservation (FP) methods for YBC patients [12,13]. Recognizing the importance of FP, the American Society of Clinical Oncology (ASCO) issued its first FP clinical guideline in 2006, recommending oncologists discuss infertility risks and FP options with newly diagnosed patients and refer them to reproductive specialists. The 2013 update expanded this responsibility to include all oncology healthcare providers (HCPs), particularly nurses, emphasizing a multidisciplinary approach [12]. Given their expanding role in oncofertility care, nurses are well-positioned to provide FP counseling, coordinate referrals, and support patient decision-making [14,15].

However, the implementation of these guidelines varies. Globally, fewer than 10 % of eligible cancer patients utilize FP services [16–18]. Studies from the United Kingdom, United States, Canada, India, and Japan reported that only 36%–75 % of oncology HCPs routinely discussed fertility concerns, and even fewer referred patients to reproductive specialists [19–23]. Commonly cited barriers include unfamiliarity with FP among HCPs [15,24], time constraints [25], low prioritization of fertility discussions [26], and the belief that FP referrals fall outside their scope of practice [23,25,27–29]. Institutional challenges, such as inadequate connections with reproductive departments, further hinder effective FP delivery. Despite the growing emphasis on oncofertility worldwide, little is known about how HCPs in China engage in FP services.

In China, this issue is particularly urgent. China, home to one-fifth of the global population, has an average breast cancer onset age of 48.7 years, nearly a decade earlier than in Western countries. Approximately 40 % of cases occur in women of reproductive age, indicating the urgency for effective FP strategies [30–32]. As the first point of contact for newly diagnosed patients, breast surgical HCPs play a pivotal role in ensuring timely and appropriate FP care. However, their engagement with FP in terms of knowledge, attitudes, and clinical practices remains largely unexplored.

To address this gap, this study aims to (1) assess the knowledge, attitudes, and practices of breast surgical HCPs in China regarding FP, (2) identify the barriers HCPs encounter when discussing fertility issues with YBC patients, and (3) examine factors influencing FP referral practices. By exploring these dimensions, this study seeks to provide actionable insights into improving oncofertility care delivery in China and enhance the quality of life for YBC survivors.

2. Materials and methods

This study represents the initial phase of a broader research project that encompasses a survey on FP service provision for YBC patients among surgical HCPs, development of an oncofertility training program, and an intervention to assess changes in HCPs' knowledge, attitudes, and practices. During this survey, participants' anonymity was maintained, and no interventions were implemented. An IRB waiver was obtained from the Research Ethics Board of International Peace Maternity and Child Health Hospital, Shanghai Jiao Tong University, China.

2.1. Questionnaire development

The questionnaire was developed with reference to previous validated surveys [23,25,33]. Two translators with proficiency in both English and Mandarin independently translated all the items according to the standard translation–back-translation procedure [34]. A pilot test

involving 10 HCPs was conducted to assess content, comprehension, and acceptability. Pilot test feedback guided revisions made by a multidisciplinary team that included oncologists, fertility specialists, and survey researchers.

To address specific cultural and legal contexts in China, two tailored items were included in the questionnaire. The first, "In China, only married women can receive fertility preservation treatment," assesses HCPs' understanding of local legal restrictions. The second, "The patient's family members wish to start treatment as soon as possible," addresses family influences on healthcare decisions, a barrier identified during pre-testing. The final survey, comprising 24 items, was structured into 4 domains (see [Appendix A](#)).

2.2. Measures

2.2.1. Section A Demographic and professional information

Demographic information, including age, gender, religious background, and professional details such as specialty, years of experience, and practice location, were collected.

2.2.2. Section B FP knowledge

A series of 10 true/false questions and a 4-item statement were used to assess HCPs' FP knowledge. The true/false questions were developed based on existing evidence, where each correct answer contributed one point towards a maximum score of 10. Additionally, participants rated their familiarity with the 4 FP options for YBC patients on a 4-point Likert scale, ranging from "not aware" to "very knowledgeable".

2.2.3. Section C attitudes toward FP

Five statements assessed HCPs' attitudes towards FP using a 5-point Likert scale from "strongly disagree" to "strongly agree." A higher total score indicated a more favorable attitude, with items 3 to 5 reverse-scored.

2.2.4. Section D FP practice behaviors and barriers to FP discussion

Based on established guidelines [12,13], 5 key behaviors and 4 FP options were identified and evaluated using a 4-point Likert scale (ranging from 'never' to 'always'). HCPs' perceived barriers to discussing fertility issues were assessed with a series of 13 likely/unlikely items.

2.3. Procedures

Recruitment was conducted via WeChat, China's most widely used social networking service, through accounts managed by BestOnco. This company specializes in online academic services for HCPs in breast cancer care. To ensure eligibility, BestOnco pre-screened its registered members based on the study's inclusion criteria and invited potential qualified HCPs to participate. The invitations, containing the study information and a link to the online survey, were sent via BestOnco's official WeChat business account to the personal WeChat accounts of eligible participants.

This recruitment approach leveraged BestOnco's national reach and engagement efficiency, enabling rapid sample collection. However, potential selection bias remains, as this method may disproportionately attract more digitally active healthcare professionals.

Eligible participants included board-certified surgeons and nurses from breast surgical teams across China who were actively involved in the care of YBC patients. The selection criteria were in accordance with the 2013 ASCO guideline [12], which recommends that both oncologists and nurses participate in comprehensive FP care.

The questionnaire was distributed from March 21 to May 21, 2023, and remained open until June 20, 2023. Before accessing the survey, participants provided informed consent electronically. To ensure data integrity, only complete responses were accepted, and each WeChat account was restricted to a single submission. Respondents received a

¥50 (approximately US\$7) honorarium upon completion. All responses were stored electronically, with anonymity and confidentiality maintained through unique identification numbers.

2.4. Statistical analysis

The analyses were performed using IBM SPSS Statistics for Windows, Version 24.0 (IBM). Descriptive analyses were conducted to summarize demographics of HCPs and their responses to the questionnaire.

For examining the factors influencing HCPs' referral practices, bivariate and multivariate logistic regression models were employed. In performing the logistic regression analysis, we attempted to dichotomize several variables to simplify the analysis. It was pre-specified and justified by the need to reflect clinically significant decisions, as suggested in the literature [21,25,35,36]. Specifically, we dichotomized responses to practice behavior items into "always/sometimes" versus "rarely/never". This simplification focuses on distinguishing between frequently and infrequently referring HCPs, capturing a primary behavior pattern relevant to patient referral practices. Similarly, attitudes towards FP were categorized as "favorable" if HCPs responded "strongly agree/agree" to at least 3 out of 5 questions, and "unfavorable" otherwise. It was to capture a meaningful threshold that signifies a positive attitude.

Variables for the multivariate logistic regression model were selected based on several criteria: (1) variables with a p-value <0.05 in the univariate analyses were initially considered for inclusion; (2) variables deemed clinically important, regardless of their p-values being >0.05, such as "type of facility", were also included. Prior to inclusion, potential multicollinearity among variables was assessed using variance inflation factors (VIF). Only variables with VIF less than 5 were included to ensure the stability and interpretability of the model. The backward elimination method was used for refining the multivariate model, where variables with a p-value <0.05 were retained in the final model. The Hosmer-Lemeshow goodness-of-fit test was used to estimate the goodness-of-fit of the logistic regression model. Odds ratios (ORs) and 95 % confidence intervals (CIs) for each predictor in the model were calculated to quantify the strength and precision of associations.

3. Results

3.1. Demographic and professional characteristics of breast surgical HCPs

A total of 2,153 participants were invited, and 582 submitted their questionnaires. After excluding 78 ineligible responses and respondents were ineligible and excluded. Invalid questionnaires were identified based on response time, including those completed in less than 5 min or containing inconsistent data, 355 valid questionnaires remained, resulting in an effective response rate of 61.00 %.

Table 1 summarizes HCPs' detailed demographics and professional characteristics. Respondents came from all 34 provincial-level administrative regions of mainland China. Overall, the sample predominantly consisted of female (67.3 %), with a median age of 37 years (IQR: 33–45 years). The sample included 232 surgeons and 123 nurses. Participants had a median of 12 years of practice experience (IQR: 7–19 years) and 9 years of experience in breast cancer care (IQR: 5–15 years). Additionally, 55.8 % reported having a reproductive unit in their hospital, and 54.1 % stated that FP services were integrated at their hospital for cancer patient.

3.2. Knowledge, attitude, and practices of breast surgical HCPs on FP

Table 2 details the results from the FP knowledge assessment. Respondents achieved a mean FP knowledge score of 6.05 ± 1.94 (range 0–10), with individual question accuracy rates ranging from 31.0 % to 92.4 %. Analysis of familiarity with specific FP methods showed that while 41.1 % of the participants reported being knowledgeable about

Table 1

Demographic and specialty characteristics of respondents (n = 355).

| Variable | n | Percentage (%) |
|---|-----|----------------|
| Age Category | | |
| <35 | 120 | 33.8 |
| 35–45 | 173 | 48.7 |
| >45 | 62 | 17.5 |
| Gender | | |
| Male | 116 | 32.7 |
| Female | 239 | 67.3 |
| Ethnic groups | | |
| Han Chinese | 339 | 95.5 |
| Ethnic minorities | 16 | 4.5 |
| Having Religion | | |
| Yes | 10 | 2.8 |
| None | 345 | 97.2 |
| Relationship status | | |
| Married/Partner | 300 | 84.5 |
| Single/Divorced/Widowed | 55 | 15.5 |
| Having Children | | |
| Yes | 263 | 74.1 |
| No | 92 | 25.9 |
| Education | | |
| Bachelor's degree or below | 192 | 54.1 |
| Master's degree | 104 | 29.3 |
| Doctoral degree | 59 | 16.6 |
| Specialty | | |
| Surgeon | 232 | 65.4 |
| Nurse | 123 | 34.6 |
| Professional title | | |
| Junior | 85 | 23.9 |
| Intermediate | 140 | 39.4 |
| Senior | 130 | 36.7 |
| Practice Location | | |
| Developed regions | 95 | 26.8 |
| Moderately developed regions | 153 | 43.1 |
| Underdeveloped regions | 107 | 30.1 |
| Facility Type | | |
| General hospital | 253 | 71.3 |
| Specialized cancer center | 102 | 28.7 |
| Hospital Level | | |
| Tertiary level | 300 | 84.5 |
| Secondary level or below | 55 | 15.5 |
| Years of clinical practice | | |
| <10 years | 115 | 32.4 |
| 10–20 years | 173 | 48.7 |
| >20 years | 67 | 18.9 |
| Years in breast cancer practice | | |
| <10 years | 210 | 59.2 |
| 10–20 years | 118 | 33.2 |
| >20 years | 27 | 7.6 |
| Having a reproductive unit | | |
| Yes | 198 | 55.8 |
| No | 147 | 41.4 |
| Not sure | 10 | 2.8 |
| Integration of fertility preservation in routine work | | |
| Yes | 192 | 54.1 |
| No | 116 | 32.7 |
| Not sure | 47 | 13.2 |

using gonadotropin-releasing hormone agonist (GnRHa), awareness of other FP methods was much lower, ranging from 3.9 % to 5.6 %, as depicted in Fig. 1A.

Overall, HCPs demonstrated a favorable attitude towards FP for YBC patients. Specifically, 82.8 % of respondents agreed or strongly agreed that they should participate in FP for patients, and 87 % expressed willingness to discuss fertility issues with patients. On the other hand, 53.5 % agreed or strongly agreed that cancer treatment should take priority over FP. Additionally, 38.3 % of HCPs doubted the success rate of FP treatment, considering it insufficient to become a routine option (see Table 3).

In clinical practice, nearly half respondents (175/355; 49.3 %) reported having never consulted any guidelines regarding FP. Additionally, 55.7 % of HCPs reported sometimes or always informing patients

Table 2

The distribution of fertility preservation knowledge among respondents (n = 355).

| Questions | Correct answer | Correct answer rate (n, %) |
|--|----------------|----------------------------|
| GnRHa is very useful for protecting the ovary during chemotherapy. | True | 328 (92.4) |
| Ovarian tissue can be collected and transported for centralized cryopreservation and storage. | True | 311 (87.6) |
| Chemotherapy for breast cancer may damage ovarian function and lead to infertility. | True | 285 (80.3) |
| In China, only married women can receive fertility preservation treatment. | False | 271 (76.3) |
| The pregnancy rate after fertility preservation is similar for cancer and other infertile patients. | True | 208 (58.6) |
| The use of letrozole to induce ovulation in breast cancer patients will affect their recurrence/prognosis. | False | 169 (47.6) |
| Ovulation induction is unsafe for breast cancer patients with BRCA gene mutations. | False | 167 (47.0) |
| Ovulation induction is unsafe for patients undergoing neoadjuvant chemotherapy. | False | 162 (45.6) |
| Ovulation induction is unsafe for breast cancer patients with hormone receptor-positive status. | False | 137 (38.6) |
| Pregnancy in breast cancer patients could increase the risk of recurrence and deterioration. | False | 110 (31.0) |

about treatment-related infertility risks, 42.3 % reported discussing FP options with patients, and 44.7 % reported having referred patients to a fertility specialist (see Table 4). Among the methods discussed with patients, oocyte cryopreservation was the least commonly suggested (35.2 %), while the use of GnRHa during chemotherapy was the most commonly suggested (64.5 %; Fig. 1B).

3.3. Barriers to discussing fertility issues

The top five barriers perceived by HCPs in discussing fertility issues with patients were poor prognosis (87.0 %), urgency to start chemotherapy (67.9 %), financial burden (60.0 %), patients not expressing a desire for fertility (59.2 %) and family members' involvement in treatment (56.1 %), as outlined in Table 5.

3.4. Factors influencing referral practices

3.4.1. Simple bivariate analyses

We conducted a comparison between the HCPs who made frequent

referrals to reproductive specialists and those who did not. In univariate models, HCPs' referral behavior was significantly associated with age, gender, specialty, professional title, years of clinical practice, practice location, the integration of FP in routine work, and the knowledge scores on FP and attitudes towards FP.

3.4.2. Multivariate logistic regression analysis

The backward elimination method identified significant predictors for patient referrals (see Table 6). HCPs with over 20 years of experience were three times more likely to refer patients than those with less than 10 years of experience ($OR = 2.93$; $p = 0.001$). HCPs in hospitals with integrated FP services were twice as likely to make referrals ($OR = 1.83$; $p < 0.0001$). Higher FP knowledge among HCPs increased the likelihood of patient referrals ($OR = 1.23$; $p < 0.0001$). HCPs in moderately developed regions ($OR = 0.51$; $P < 0.05$) and underdeveloped regions ($OR = 0.37$; $p < 0.01$) were less likely to refer patients than those in developed regions. Additionally, HCPs in specialized cancer centers were less likely to refer patients than those in general hospitals ($OR = 0.55$; $p < 0.05$).

4. Discussion

This survey investigated the knowledge, attitudes, and practices of the HCPs in surgical teams in China regarding FP for YBC patients. FP is often feasible during the interval between surgery and chemotherapy, minimizing treatment delays [20,37]. Surgical teams were specifically targeted in this study due to their critical role as the first point of contact for these patients, facilitating timely discussions and referrals. To our knowledge, this is the first nationwide survey on the role of surgical HCPs in oncofertility in China, conducted nearly 20 years after the publication of the ASCO guidelines. Our findings indicate that adherence to FP guidelines remains suboptimal, with notable gaps compared to practices in other regions.

In this study, nearly half of the HCPs had never consulted any FP guidelines, reflecting a poorer performance compared to similar surveys conducted in Europe, Canada, and other low- and middle-income countries [20,23,33]. The guidelines recommend that HCPs inform cancer patients about treatment-related infertility risks and discuss available FP options [13,38,39]. Our study found that only 55.7 % of HCPs in China sometimes or always informed patients about infertility risks. Furthermore, patient-reported data indicated that only 23.4 %–26.4 % of YBC patients in China received fertility related discussions [40,41]. It implies that the actual occurrence of such discussions may be even lower. In contrast, 95 % of oncologists in the United States

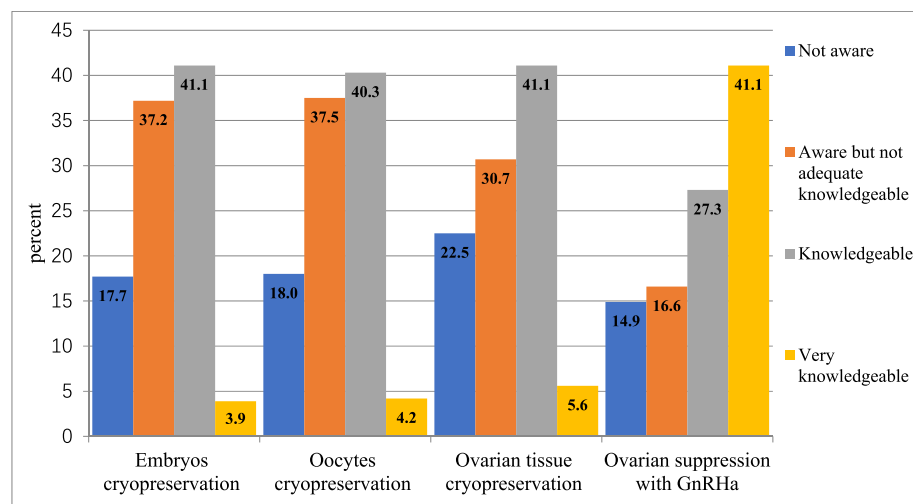


Fig. 1A. Healthcare providers' knowledge about fertility preservation methods for young breast cancer patients.

Table 3
Healthcare providers' attitudes towards fertility preservation for young breast cancer patients (n = 355).

| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|--|-------------------|------------|-----------------|-----------------|----------------|
| I think I should participate in the fertility preservation for breast cancer patients. | 2(0.6 %) | 1(0.3 %) | 58 (16.3 %) | 186 (52.4 %) | 108(30.4 %) |
| I am willing to discuss fertility preservation issues with patients. | 3(0.8 %) | 0 | 43 (12.1 %) | 194 (54.6 %) | 115(32.4 %) |
| I think cancer treatment should take priority over fertility preservation. | 5(1.4 %) | 38(10.7 %) | 122 (34.4 %) | 141 (39.7 %) | 49(13.8 %) |
| I think patients may transmit cancer to their offspring. | 20(5.6 %) | 59(16.6 %) | 80 (22.5 %) | 156 (43.9 %) | 40(11.3 %) |
| I think the success rate of fertility preservation is not yet sufficient to become a routine option. | 12(3.4 %) | 84(23.7 %) | 123 (34.6 %) | 115 (32.4 %) | 21(5.9 %) |

Table 4
Healthcare providers' practice behaviors regarding fertility preservation (n = 355).

| | Never | Rarely | Sometimes | Always |
|---|-----------------|-----------------|-------------|------------|
| Inform treatment-related infertility risks with patients | 25(7.0 %) | 132 (37.2 %) | 112(31.5 %) | 86(24.2 %) |
| Discuss fertility preservation options with patients before treatment | 33(9.3 %) | 172 (48.5 %) | 108(30.5 %) | 42(11.8 %) |
| Refer interested patients to reproductive specialists | 32(9.0 %) | 164 (46.2 %) | 96(27.0 %) | 63(17.7 %) |
| Seek advice from reproductive specialist | 46 (13.0 %) | 174 (49.0 %) | 86(24.2 %) | 49(13.8 %) |
| Provide patients fertility related educational materials | 232 (65.4 %) | 65(18.3 %) | 48(13.5 %) | 10(2.8 %) |

routinely discussed infertility risks, and 91.6 % of HCPs at two international breast cancer conferences (BCY3 in Switzerland, 2016, and BCC 2017 in Austria, 2017) reported usually discussed such issues [29]. As is known, when HCPs do not initiate these conversations, patients may hesitant to bring up the topic or remain unaware of FP opportunities [25]. Therefore, our finding reveals the urgent need to improve the initiation of oncofertility discussions in clinical practice.

Our studies also revealed that only 42.3 % of HCPs sometimes or always discussed FP options with their patients, exposing a critical shortfall in the delivery of comprehensive oncofertility counseling. Among the standard FP methods recommended by guidelines, only 3.9 %–5.6 % of respondents reported being very knowledgeable about the three cryopreservation methods (oocyte, embryo, or ovarian tissue cryopreservation), compared to 41.1 % who were knowledgeable about ovarian suppression with GnRHa.

This trend was reflected in clinical practice, with 64.5 % of HCPs most frequently recommending GnRHa for YBC patients. However, while GnRHa has demonstrated effective in reducing chemotherapy-induced premature ovarian insufficiency (POI), data on post-treatment pregnancy outcomes remain limited [42,43]. Therefore, GnRHa should not be considered a standalone alternative to cryopreservation methods [44,45]. These findings suggest that even when fertility-related

discussions occur, patients may not be offered the comprehensive FP options recommended by guidelines. Therefore, educational interventions to improve knowledge of these FP methods and ensuring adherence to guideline-based counseling are critical steps toward improving oncofertility care for YBC patients in China.

Although respondents seldom initiated oncofertility discussions, over 80 % expressed a favorable attitude towards engaging in them. This discrepancy between attitude and practice highlights the need to identify and address the underlying barriers [46–48]. Previous studies have cited barriers such as the perceived inability to delay treatment, lack of patient interest, increased workload, financial burden, high risk of disease recurrence, and urgency of initiating cancer treatment [22,25,49,50]. Our findings largely align with these observations. It's worth noting that financial burden, treatment urgency, and the presence of existing children were frequently cited barriers by HCPs in this study. All these factors suggest a paternalistic approach, where HCPs decide whether to discuss FP based on their own assumptions about patient priorities. However, such decisions may conflict with patients' actual preferences and compromise their autonomy in making informed choices about FP.

Furthermore, cultural influences complicate this issue. This study showed that 56.1 % of HCPs reported that family members' opinions influenced their decision to discuss infertility issues. It might be explained by the impact of Confucian values that emphasize family harmony and collective decision-making [51,52]. In this context, family involvement in patient care is often considered acceptable, and they may frequently act as primary decision-makers. While respecting these cultural norms is essential, it is equally important to ensure that family-driven decisions do not override patient autonomy or limit access to comprehensive FP information.

Additionally, 50.7 % of HCPs reported that having existing children influenced their decision to initiate FP discussions, implying an assumption that these patients have no further reproductive desires. This perspective likely stems from China's former one-child policy (1979–2015), which shaped societal views of family completeness with one child. However, research shows that women with children may still have reproductive goals, such as expanding their families or having children with new partners [3]. With the introduction of the three-child policy (since 2021), which encourages larger families, this assumption may no longer reflect patients' desires. To address these barriers, fostering shared decision-making among patients, families, and HCPs is essential [53,54]. Research shows that patient engagement in decision-making leads to better outcomes, including reduced decisional conflict and increased satisfaction, as this approach respects cultural norms and empowers patients to make informed decisions aligned with their reproductive goals.

Early referral to reproductive specialists is a key recommendation in FP guidelines as part of comprehensive cancer care. Referral rates to fertility specialists, however, vary widely across regions. While referral rates in developed countries range from 47 % to 82 % in the United States [25,29], 67 % in the United Kingdom [36], and 76 % in Italy [26], rates in developing regions such as Latin America and India vary between 52 % and 85 % [22,55]. In our study, only 44.7 % of breast surgical HCPs in China reported always or sometimes referring patients for FP. In parallel, a study conducted in Fujian, Southeast China, explored the perspective of reproductive specialists and found that only 30.4 % of them had ever been consulted by cancer patients regarding FP [40]. This finding indirectly indicates the likelihood that many cancer patients in China may not receive timely referrals to reproductive services. Addressing these referral gaps is essential to improve access to FP services and enhance the quality of oncofertility care for YBC patients.

Our study identified several factors associated with HCPs' referral behaviors for FP in young YBC patients. HCPs with higher FP knowledge scores or longer clinical experience were more likely to make referrals. This finding demonstrates the importance of ongoing education and clinical exposure, consistent with prior research which emphasizes the role of knowledge in implementing clinical practice changes [21,35,49,

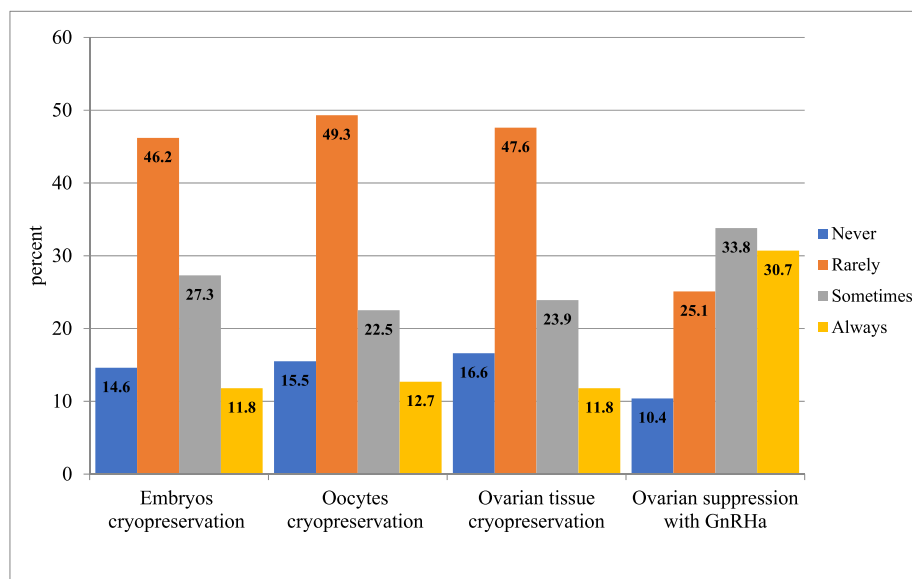


Fig. 1B. Healthcare providers' introduction of fertility preservation methods to young breast cancer patients.

Table 5

Healthcare providers' perceived barriers to discussing fertility issues (n = 355).

| Barrier Items | n (%) |
|--|-------------|
| The patient has a poor prognosis | 309(87.0 %) |
| The patient has financial burden | 241(67.9 %) |
| The patient needs to start chemotherapy without delay | 213(60.0 %) |
| The patient has not expressed a need for fertility | 210(59.2 %) |
| The patient's family members wish to start treatment as soon as possible | 199(56.1 %) |
| The patient already has child/children | 180(50.7 %) |
| Lack of professional collaboration with a reproductive center | 128(36.1 %) |
| Lack of unfamiliar reproductive specialists | 108(30.4 %) |
| Lack of (information about) available reproductive center nearby. | 96(27.0 %) |
| Regular work is too occupied | 87(24.5 %) |
| It is someone else's responsibility to address fertility issues | 77(21.7 %) |
| I feel uncomfortable when discussing fertility issues | 74(20.8 %) |
| Religious or cultural barrier related to fertility preservation procedures | 47(13.2 %) |

Note: The barriers are sorted from highest to lowest based on the percentage of respondents who identified them as barriers.

56]. Given the mean FP knowledge score of only 6.05, common deficiencies were noted among HCPs such as the safety of pregnancy and the use of controlled ovarian stimulation (COS) in YBC patients. These knowledge gaps in FP will guide our next research phase, focusing on knowledge translation interventions to enhance FP service delivery.

System-level factors were also identified as influencing HCPs' referral behaviors. HCPs working in hospitals with integrated FP services were more likely to refer patients, highlighting the importance of embedding FP into routine oncology care. However, the lack of detailed data on specific FP integration models in our study limits our understanding of the effective strategies. Additionally, HCPs in specialized cancer centers were less likely to refer patients compared to those in general hospitals, likely due to the emphasis on cancer treatment and the absence of established referral pathways to reproductive specialists [24].

Geographic disparities further exacerbate these challenges. Referral

Table 6

Factors associated with healthcare providers' referrals to reproductive specialist among breast cancer patients (n = 355).

| | Univariate logistic regression | | Multiple logistic regression ^a | |
|---|--------------------------------|----------|---|----------|
| | OR (95 % CI) | p-value | OR (95 % CI) | p-value |
| Years of clinical practice | | | | |
| <10 years | Ref | | Ref | |
| 10–20 years | 0.83 (0.52, 1.34) | 0.447 | 0.69 (0.41, 0.16) | 0.161 |
| >20 years | 3.11 (1.69, 5.72) | <0.001** | 2.98 (1.55, 5.72) | 0.001** |
| Practice Location | | | | |
| Developed regions | Ref | | Ref | |
| Moderately developed regions | 0.60 (0.36, 1.00) | 0.051 | 0.51 (0.29, 0.90) | 0.020* |
| Underdeveloped regions | 0.35 (0.20, 0.63) | <0.001** | 0.37 (0.20, 0.69) | 0.002** |
| Type of facility | | | | |
| General hospital | Ref | | Ref | |
| Specialized cancer center | 0.69 (0.43, 1.10) | 0.116 | 0.55 (0.36, 0.93) | 0.026* |
| Integration of fertility preservation in routine work | | | | |
| No/Not sure | Ref | | Ref | |
| Yes | 1.74 (1.37, 2.22) | <0.001** | 1.83 (1.41, 2.39) | <0.001** |
| Fertility preservation knowledge score | 1.23 (1.10, 1.38) | <0.001** | 1.21 (1.07, 1.37) | 0.002** |

Notes: OR, odds ratio; 95 % CI, 95 % confidence interval.

One asterisk (*) indicates $p < 0.05$, two asterisks (**) indicate $p < 0.01$.

^a Only variables with $p < 0.05$ in the univariate logistic regression models were entered into the multiple logistic regression model.

rates were lower in underdeveloped regions, reflecting disparities in access to FP resources. In China, approximately 25.4 % of the population lacks access to FP service [57], forcing patients to seek care across regions and endure significant time and financial burdens.

In recent years, promising strategies have been developed to address

the barriers, such as oncofertility navigation programs. Oncofertility navigators facilitate FP by providing medical information, coordinating communication among medical teams, scheduling appointments, and guiding patients through the FP process [14,27,58]. For instance, telemedicine combined with oncofertility nurse navigators has successfully delivered FP services to patients in remote areas, minimizing patient travel burdens [59]. Similarly, at Radboud University Medical Center, the implementation of fertility nurses as navigators ensures continuous guidance and streamlined care throughout the FP process [60]. In China, where FP referral pathways for YBC patients are still evolving, adopting successful models like oncofertility navigation programs might bridge existing gaps in access. Future efforts should focus on developing navigator training programs to equip HCPs with the necessary skills for effective patient support. Pilot initiatives and telemedicine integration may help adapt these models, enhancing FP services and improving access in underserved regions.

Our study has several limitations that should be considered when interpreting the results. First, recruitment via social networking platforms may have introduced selection bias, favored digitally active HCPs and potentially excluded those less engaged online, which could limit the representativeness of the sample. However, this approach effectively engaged surgical HCPs, a challenging group to recruit, yielding a satisfactory response rate. Second, the absence of data on non-responders prevents comparison with responders, introducing potential non-response bias and limiting the generalizability of the findings. Third, our survey relied on self-reported data, which is inherently susceptible to social desirability and recall biases. Respondents may have answered in ways they perceived as favorable, rather than providing accurate reflections of their knowledge, attitudes, or practices. Despite mitigation efforts, such as anonymous surveys and true/false questions, these biases cannot be entirely eliminated. Fourth, while respondents represented all 34 provincial-level regions of mainland China, participation was uneven, with most respondents from tertiary hospitals. Therefore, the findings may not fully reflect practices in primary or secondary healthcare settings, where FP resources are more limited. Finally, our study focused solely on HCPs' perspectives. Including the perceptions of patients and families in future research would provide a more comprehensive understanding of FP barriers and unmet needs, particularly within China's cultural context.

This study reveals significant gaps in FP practices among breast surgical HCPs in China, including inadequate patient counseling, limited discussions of FP options, and low referral rates to reproductive specialists. These findings highlight the urgent need for tailored interventions and policy reforms to improve oncofertility care in the Chinese context. Developing targeted FP training programs, integrating culturally informed shared decision-making practices, and establishing oncofertility navigation systems across diverse healthcare settings is recommended to enhance access to FP services and ensure equitable, patient-centered care for young breast cancer patients. This study provides crucial baseline data for future initiatives.

CRediT authorship contribution statement

Xiaoling Yuan: Writing – original draft, Project administration, Methodology, Investigation, Conceptualization. **Jingdan Li:** Writing – original draft, Resources, Methodology, Conceptualization. **Nan Zhang:** Resources, Methodology, Investigation, Data curation. **Jiayi Peng:** Visualization, Formal analysis, Data curation. **Xiaoran Yang:** Visualization, Formal analysis, Data curation. **Wen Li:** Writing – review & editing, Supervision, Project administration, Methodology, Conceptualization.

Ethical approval

An IRB waiver was granted by the Research Ethics Board of International Peace Maternity and Child Health Hospital, Shanghai Jiao Tong

University, China. Informed consent was obtained from each participant in the study.

Data statement

We confirm that all data relevant to the conclusions have been reported in the results of this manuscript. No data have been omitted or excluded from the analyses presented herein. The datasets utilized in this study are available from the corresponding author.

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Declaration of competing interest

All authors have declared no conflicts of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.breast.2025.104426>.

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