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ORIGINAL RESEARCH

Factors Influencing Psychological Dysfunction and Prediction Model in Breast Cancer Patients with Postoperative Fear of Disease

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Background: Fear of disease progression is a prevalent psychological challenge among breast cancer survivors, often leading to significant psychological dysfunction and serious sequelae, such as post-traumatic stress syndrome and impaired immunity. However, the factors influencing this dysfunction in the early postoperative period remain unclear. Therefore, this study aimed to identify the influencing factors and construct a risk-prediction model for psychological dysfunction in breast cancer patients with postoperative fear of disease.

Methods: Using convenience sampling, we selected 202 patients who underwent breast cancer surgery in a Class III Grade A hospital in Jiangsu Province, between January and August 2024. All patients completed a general information questionnaire (which collected data on tumor stage), disease-related scales, the Fear of Progression Questionnaire-Short Form, a breast cancer quality-of-life scale, the Posttraumatic Growth Inventory, and the Fear of Cancer Recurrence-Short Form.

Results: Of the 202 patients, 75 (37.1%) developed psychological dysfunction. Single-factor analyses revealed that factors such as tumor stage, education level, surgical method, fear of cancer recurrence, and quality of life ($P < 0.05$) were significantly related to psychological dysfunction. Logistic regression revealed education level, surgical method, fear of cancer recurrence, and quality of life as influencing factors for psychological dysfunction ($P < 0.05$). The Hosmer-Lemeshow goodness-of-fit test of the model showed a result of $\chi^2 = 4.179$ ($P = 0.841$). The area under the receiver operating characteristic curve was 0.860 (95% confidence interval: 0.807–0.912). The Youden index was 0.617; the sensitivity and specificity of the optimal cut-off value were 0.853 and 0.764, respectively.

Conclusion: Breast cancer patients with postoperative fear of disease have a high risk of psychological dysfunction, which is influenced by factors such as surgical method, education level, postoperative quality of life, and fear of cancer recurrence.

Keywords: breast cancer, fear of disease progression, psychological dysfunction, influencing factor analysis, risk prediction model, nursing care

Introduction

The 2024 Global Cancer Report showed that breast cancer is now the second most common female cancer in China.[1] Surgery is an important treatment method for breast cancer, but patients face many physical and mental challenges after surgery.[2] Thanks to advances in diagnosis and treatment, and the clinical application of effective drugs, the 5-year survival rate of breast cancer patients has significantly improved to 80.9%.[3] However, the impact of mental health status on the survival rate and quality of life of patients cannot be ignored.[4] Studies have shown that during the disease course and treatment of breast cancer, many patients experience anxiety about tumor progression,[5] which mainly includes worries about recurrence, metastasis, and deterioration of the disease.[6] This psychological state of fear of disease progression is particularly prominent in breast cancer patients, and it is often regarded as an unmet need by breast

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cancer patients.[7] The high prevalence of fear of progression and its association with factors like younger age, low social support, and neuroticism have been well established in prior studies.[8–10] Furthermore, existing research has primarily focused on this fear itself as an outcome during long-term survivorship or during active treatment phases like chemotherapy.[11,12] In the postoperative period, the fear of disease may be aggravated to the point of causing psychological dysfunction, which can have serious impacts on the physical and mental health of breast cancer patients, such as sleep disorders, memory-processing problems, post-traumatic stress syndrome, and even impaired immune-system function.[13,14] While the global literature has begun to explore the fear of progression, few studies worldwide—and even fewer in China—have specifically investigated the subsequent psychological dysfunction triggered by the fear of disease in the immediate postoperative period, or developed predictive models for this population. The causes of psychological dysfunction in breast cancer patients with fear of disease after surgery are unclear, and the existing research mainly focuses on breast cancer patients' fear of disease progression.[15,16] In this context, a validated risk-prediction model is particularly valuable, as it would enable the early detection of high-risk patients, facilitating targeted interventions and efficient resource allocation to improve outcomes. Therefore, this study aims to identify the factors influencing the occurrence of psychological dysfunction in patients with fear of disease after breast cancer surgery and to construct a risk-prediction model, to enable the provision of more effective psychological intervention strategies in clinical practice.

Methods

Respondents

Selection Criteria and Ethics Statement

From January 2024 to August 2024, convenience sampling was used to select postoperative breast cancer patients treated in the Department of Breast Surgery of a Class III, Grade A hospital in Jiangsu Province as the survey subjects. The inclusion criteria were as follows: (1) female patients; (2) patients aged ≥ 18 years, who were able to move freely, and were fully conscious; (3) patients who had undergone surgery for breast cancer; (4) patients with normal communication and understanding ability; and (5) patients (or their family members) who could use a computer or a mobile phone to access the internet. The exclusion criteria were as follows: (1) distant metastasis; (2) serious organ diseases; (3) mental diseases, such as schizophrenia and depression; and (4) prior receipt of neoadjuvant chemotherapy or radiotherapy, to ensure that the assessment of psychological status was focused on the impact of surgery and the cancer diagnosis itself. This study was approved by the ethics committee of our hospital (approval code: 2023-SR-770) and was performed in compliance with the Declaration of Helsinki. All subjects provided written informed consent.

Recruitment Process

A convenience sampling method was employed for feasibility. To enhance representativeness, all eligible patients admitted during the study period were invited to participate consecutively. The baseline characteristics of our sample were comparable to those in larger national cohorts,[17] suggesting reasonable representativeness. Potential participants were identified by ward staff. Eligible patients were invited on the second postoperative day to ensure sufficient recovery for informed consent and reliable questionnaire completion. A researcher then explained the study in detail and obtained written informed consent prior to data collection.

Sample-Size Estimation

Through a literature review, we finally included 15 predictive variables in this study. According to the sample-size calculation requirements for logistic regression analysis,[18] 5–10 patients were required for each independent variable. According to the study by Pan et al,[19] the incidence of psychological dysfunction due to fear of disease progression is 52.67% in breast cancer patients. To account for sample losses caused by incomplete patient data and other reasons, we increased the sample size by 10%. Hence, the required sample size of this study was 157–313 patients, and 202 patients were included. A post-hoc power analysis was performed to verify sample-size adequacy. With the observed effect size (Cohen's $f^2 = 0.23$, calculated from the model's $R^2 = 0.19$), alpha = 0.05, and 4 predictors, the analysis performed using

G*Power *v*3.1 yielded a statistical power of 92.3%. This exceeds the recommended 80% threshold, confirming that the sample size (n = 202) was sufficient to detect meaningful effects.

Survey Tools

General Information Questionnaire

A self-designed questionnaire was used to collect the general information and disease-related data of patients, including age, education level, marital status, surgical method, and tumor stage.

Fear of Progression Questionnaire-Short Form

The Fear of Progression Questionnaire-Short Form (FoP-Q-SF) was revised from the Fear of Progression Questionnaire by Mehnert et al[20] in 2006. The FoP-Q-SF is used to assess the fear of disease recurrence and progression in cancer patients. A Likert 5-point scale is used for scoring, and the total questionnaire score ranges from 12 to 60 points. A total score ≥ 34 points was used as the cut-off value to indicate the presence of clinically significant psychological dysfunction.[21,22] The reliability and validity of the Chinese version of the FoP-Q-SF were tested for the first time by Wu et al in 2015,[23] and the results showed that the scale had good reliability and validity. The overall Cronbach α of the scale was 0.907, while the Cronbach α of the physical health dimension, and the social and family dimension were 0.856 and 0.818, respectively.

Functional Assessment of Cancer Therapy-Breast

The Functional Assessment of Cancer Therapy-Breast (FACT-B) instrument was developed by Cella et al at the American Medical Research Center.[24] Wan et al[25] translated it into Chinese in 2002. There are 5 dimensions and 36 items in total in the Chinese version of the FACT-B instrument. The quality of life of breast cancer patients was assessed using the Chinese version of the FACT-B instrument. In this study, the overall Cronbach α of the instrument was 0.70, and the Cronbach α of each dimension ranged from 0.687 to 0.888.

Posttraumatic Growth Inventory

The Posttraumatic Growth Inventory (PTGI) was developed by Tedeschi and Calhoun[26] in 1996. The scale used in this investigation was the Chinese version developed by Wang et al.[27] It has 21 items and 5 dimensions, and a Likert 6-point scale is used for scoring. The total score can range from 0 to 105 points, and is interpreted as follows: <60 points, low level; 60–85 points, medium level; and ≥86 points, high level of posttraumatic growth. In this study, the Cronbach α of the PTGI was 0.957, and the Cronbach α of each dimension was 0.907, 0.837, 0.869, 0.911, and 0.929.

Fear of Cancer Recurrence Inventory-Short Form

The Fear of Cancer Recurrence Inventory-Short Form (FCRI-SF) is a simplified version of the Fear of Cancer Recurrence Inventory (FCRI). Simard and Savard in 2015 reported that the FCRI-SF has good reliability and validity.[28] This scale adopts a rating system from 0 to 4, with a total of 9 items. The total score ranges from 0 to 36. The higher the total score, the more severe the fear of cancer recurrence in patients. People with an FCRI score of or exceeding 13 are considered to have a high level of fear of cancer recurrence.[28,29] In this study, the Cronbach α of the FCRI-SF was 0.843.

Data-Collection methods

This study collected data from patients 2 days after their surgeries. Online, the data were collected through the questionnaire star app; offline, the questionnaires were collected in paper form. Before the study, the purpose, contents, and confidentiality of the study were explained to the patients, and signed informed consent forms were obtained. The online questionnaires were limited to ensure their validity and completeness; the system would automatically generate prompts if there were unanswered questions, and only one answer could be given per mobile phone in the offline mode. The answering process was guided by professionals, and for those with visual or cultural limitations, researchers should conduct the questioning and recording of answers themselves. To minimize interviewer bias in these cases, all researchers received prior training to administer questionnaires using a standardized, neutral protocol. They were instructed to read the questions and response

options verbatim without providing additional explanation or interpretation. A total of 217 questionnaires were distributed, and 202 valid completed questionnaires were returned, yielding an effective recovery rate of 93.1%.

Statistical Analysis

SPSS *v*26.0 software was used for data analysis. Quantitative data conforming to the normal distribution were expressed as mean ± standard deviation, and compared between 2 groups by using the independent-samples *t*-test. Quantitative data not meeting the normal distribution were presented as median (interquartile range), and compared between 2 groups by using the rank sum test. Qualitative data were reported as the number of cases (percentage), and compared between 2 or more groups by using the χ^2 test or the Fisher exact probability method. Parameters with statistical significance in the single-factor analyses were entered into logistic regression analysis. The judgment of multicollinearity was made using the variance inflation factor (VIF); a VIF value > 10 indicated a linear correlation. The area under the receiver operating characteristic (ROC) curve and Hosmer Lemeshow goodness-of-fit test were used to evaluate the predictive performance of nomograms based on the multivariate regression model, and construct a column chart. Two-sided tests were used in this study, and $P < 0.05$ was considered to indicate statistical significance.

Results

Single-Factor Analysis of Factors Associated with Psychological Dysfunction in Patients with Fear of Disease After Breast Cancer Surgery

A total of 202 patients were included in this study, and all of them were female. Among them, 75 patients experienced postoperative psychological dysfunction (defined as an FoP-Q-SF score ≥ 34 points), resulting in an incidence rate of 37.1%. The single-factor analyses revealed that the following factors were significantly related to psychological dysfunction after breast cancer surgery: different levels of education, time spent learning about the disease every day, postoperative edema, degree of postoperative pain, postoperative psychological change, operation method, tumor stage, quality of life, posttraumatic growth, FCRI-SF scores, and FoP-Q-SF scores ($P < 0.05$; Table 1). Multicollinearity tests were conducted for the above 10 influencing factors. The results showed that all the VIF values were less than 10, indicating that there was no collinearity among the variables.

Table 1 Single-Factor Analysis of Factors Influencing Postoperative Psychological Dysfunction in Breast Cancer Patients with Fear of Disease (n = 202)

Factor	No Psychological Dysfunction Group (n = 127)	Psychological Dysfunction Group (n = 75)	Statistical value	*P*
Age (years)			0.742[a]	0.863
18–44	27 (21.3)	14 (18.7)		
45–59	71 (55.9)	46 (61.3)		
60–74	26 (20.5)	14 (18.7)		
≥75	3 (2.4)	1 (1.3)		
Level of education			10.126[a]	0.018
Illiterate	27 (21.3)	22 (29.3)		
Primary school	41 (32.3)	35 (46.7)		
Secondary school	28 (22.0)	9 (12.0)		
College degree or above	31 (24.4)	9 (12.0)		
Married			0.141[a]	0.708
No	8 (6.3)	3 (4.0)		
Yes	119 (93.7)	72 (96.0)		

(*Continued*)

Table 1 (Continued).

Factor	No Psychological Dysfunction Group (n = 127)	Psychological Dysfunction Group (n = 75)	Statistical value	*P*
Income			3.293[a]	0.349
<2000/month	35 (27.6)	27 (36.0)		
2001–5000/month	52 (40.9)	32 (42.7)		
5001–10,000/month	29 (22.8)	13 (17.3)		
>10,000/month	11 (8.7)	3 (4.0)		
Career			0.164[a]	0.921
Employed	63 (49.6)	35 (46.7)		
Retired	37 (29.1)	23 (30.7)		
Unemployed	27 (21.3)	17 (22.7)		
Study time per day*			9.248[a]	0.026
<30 min	47 (37.0)	43 (57.3)		
1 h	54 (42,5)	19 (25.3)		
2 h	12 (9.4)	8 (10.7)		
3 h or more	14 (11.0)	5 (6.7)		
Willingness to share knowledge about the disease			2.813[a]	0.245
Not willing	11 (8.7)	4 (5.3)		
Neutral	31 (24.4)	26 (34.7)		
Would love to	85 (66.9)	45 (60.0)		
Postoperative edema			13.149[a]	0.000
Absent	118 (92.9)	56 (74.7)		
Present	9 (7.1)	19 (25.3)		
Degree of postoperative pain			10.276[a]	0.016
No pain	29 (22.8)	5 (6.7)		
Mild pain	73 (57.5)	50 (66.7)		
Moderate pain	20 (15.7)	17 (22.7)		
Severe pain	5 (3.9)	3 (4.0)		
Fluid accumulation at surgical site			0.160[a]	0.689
Abnormal	7 (5.5)	6 (8.0)		
Normal	120 (94.5)	69 (92.0)		
Postoperative psychological changes			13.958[a]	0.000
Low self-esteem	26 (20.5)	34 (45.3)		
Confidence	101 (79.5)	41 (54.7)		
Postoperative drainage fluid			1.105[a]	0.293
Abnormal	11 (8.7)	10 (13.3)		
Normal	116 (91.3)	65 (86.7)		
Postoperative infection			0.000[a]	1.000
Present	7 (5.5)	4 (5.3)		
Absent	120 (94.5)	71 (94.7)		
Surgical method			6.515[a]	0.011
Breast-conserving surgery	39 (30.7)	11 (14.7)		
Total mastectomy	88 (69.3)	64 (85.3)		
Tumor stage			9.190[a]	0.027
I	36 (28.3)	21 (28.0)		
II	52 (40.9)	33 (44.0)		
III	33 (26.0)	10 (13.3)		
IV	6 (4.7)	11 (14.7)		
Quality of life	102.58 ± 15.71	86.40 ± 14.78	7.227[b]	0.000
Posttraumatic growth	79.32 ± 21.67	71.93 ± 16.78	2.708[b]	0.007
Fear of cancer recurrence	11.10 ± 5.59	17.05 ± 4.74	−7.727[b]	0.000

Notes: [a] χ^2 score; [b] T-score. *Refers to the time each patient spends on learning knowledge related to the disease.

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Results of Multivariate Analysis of Psychological Dysfunction in Patients with Fear of Disease After Breast Cancer Surgery

We performed logistic regression analysis with the occurrence of psychological dysfunction in patients with fear of disease after breast cancer surgery as the dependent variable and variables with statistical significance in the single-factor analyses as independent variables. The quality of life score, posttraumatic growth score, and fear of cancer recurrence score were entered as original values, and the scores assigned to the other variables are shown in Table 2. The results of the multivariate analysis showed that education level, postoperative edema, postoperative pain, surgical method, quality of life score, and fear of cancer recurrence score were influencing factors for fear of disease progression in breast cancer patients ($P < 0.05$; Table 3).

Construction of Risk-Prediction Model for Psychological Dysfunction in Patients with Fear of Disease After Breast Cancer Surgery

According to the results of the logistic regression analysis, a prediction model was constructed as follows: Logit P = (0.949 × surgical method) − (0.945 × education level) + (0.124 × fear of cancer recurrence) − (0.039 × quality of life) − 0.849. A nomogram was created using the above influencing factors (Figure 1).

Goodness-of-Fit and Predictive Efficacy of Risk-Prediction Model for Psychological Dysfunction in Patients with Fear of Disease After Breast Cancer Surgery

ROC curves were used to evaluate the discrimination of the prediction model. The area under the curve was 0.860 (95% CI: 0.807, 0.912), and the Youden index was 0.617. The sensitivity and specificity of the optimal cut-off value were 0.853 and 0.764, respectively (Figure 2). To ensure that the model was not overfitted, we conducted an 8:2 random-split

Table 2 Assignment of Scores for Independent Variables

Serial no.	Variable	Score Assignment
Y	Psychological function	No disorder = 0, psychological dysfunction = 1
X1	Level of education	Primary school or below = 0, secondary school or above = 1
X2	Study time per day	More than 30 min = 0, less than 30 min = 1
X3	Postoperative edema	No edema = 0, edema = 1
X4	Postoperative pain	No pain = 0, pain = 1
X5	Postoperative psychological changes	Low self-esteem = 0, confidence = 1
X6	Surgical approach	Breast conserving = 0, total resection = 1
X7	Tumor stage	I/II = 0, III/IV = 1

Table 3 Logistic Regression Analysis of Psychological Dysfunction in Breast Cancer Patients with Fear of Disease Progression

Variable	Regression Coefficient	Standard Error	Wald	*P*	OR	95% CI
Level of education	−0.945	0.398	5.639	0.018	0.389	(0.178, 0.848)
Study time per day	0.728	0.419	3.022	0.082	2.071	(0.911, 4.704)
Postoperative edema	0.842	0.561	2.252	0.133	2.322	(0.773, 6.975)
Postoperative pain	0.983	0.607	2.625	0.105	2.672	(0.814, 8.772)
Postoperative psychological changes	−0.626	0.416	2.262	0.133	0.5353	(0.237, 1.209)
Surgical method	0.949	0.479	3.919	0.048	2.583	(1.009, 6.608)
Tumor stage	−0.008	0.407	0.000	0.985	0.992	(0.447, 2.204)
Posttraumatic growth	0.012	0.013	0.854	0.355	1.012	(0.987, 1.037)
Fear of cancer recurrence	0.124	0.042	8.783	0.003	1.132	(1.043, 1.228)
Quality of life	−0.039	0.016	5.583	0.018	0.962	(0.932, 0.993)
Constant	−0.849	1.914	0.197	0.657	0.428	

Abbreviations: OR, odds ratio; CI, confidence interval.

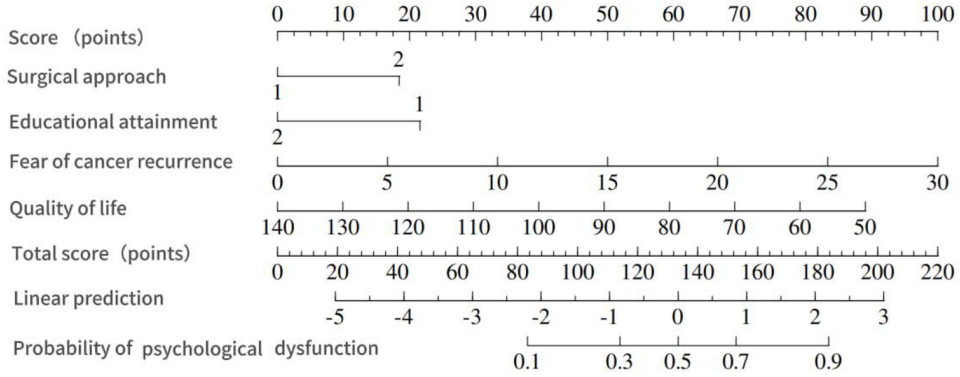

Figure 1 Nomogram for predicting the risk of psychological dysfunction in breast cancer patients.

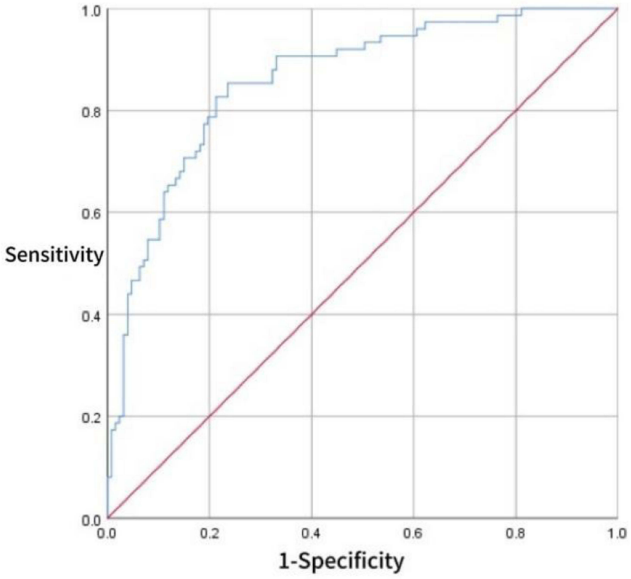

Figure 2 Receiver operating characteristic (ROC) curve of risk-prediction model for psychological dysfunction in patients after breast cancer surgery.

internal validation. The total 202 patients (75 with psychological dysfunction, 127 without) were randomly divided into a training set (n = 162, including 60 patients with psychological dysfunction and 102 without) and a validation set (n = 40, including 15 patients with psychological dysfunction and 25 without), maintaining the original event rate to avoid sampling bias. After being re-trained on the training set, the model achieved an AUC of 0.85; when tested on the validation set, the AUC of the model was 0.83. Both values were consistent with the original AUC (0.860) in the overall cohort, indicating that the model had stable discriminative ability and no overfitting. The Hosmer-Lemeshow test showed a result of $\chi^2 = 4.179$ ($P = 0.841$), suggesting that the fit of the model was good.

Discussion

Patients with Fear of Disease After Breast Cancer Surgery Have a Higher Probability of Psychological Dysfunction

In this study, the incidence of psychological dysfunction in breast cancer patients with fear of disease after surgery was 37.1%, which was lower than the incidence (56.0%) in the study by Zhang et al,[30] but higher than the incidence (33.12%) in the study by Lu et al,[31] which may be related to differences in the research samples. The study by Zhang et al included patients who received chemotherapy, and the side effects of chemotherapy (such as gastrointestinal reactions, alopecia,

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and neurotoxicity) may aggravate pain and thereby affect psychological function. In addition, the present study found that psychological dysfunction was more common in patients aged 45 years and older, suggesting that age may be one of the influencing factors of psychological dysfunction.[32] Young patients with breast cancer tend to be more concerned about changes in body image, psychological distress, and family responsibility.[16] In contrast, middle-aged and elderly female patients are more concerned about disease progression and prognosis, which significantly aggravates their fear of disease progression.[33] In our study, employed patients had a higher incidence of psychological dysfunction than retired or unemployed patients, which is similar to the finding by Deng et al.[34] This may be caused by a combination of factors such as work pressure and economic pressure. Employed patients may have concerns about work progress, career development, and decreases in income, and be influenced by the competitive environment in the workplace; therefore, they may be more prone to developing psychological dysfunction. Psychological dysfunction can induce a stress response in the body, interfering with hormonal balance and negatively affecting disease progression in patients with breast cancer, by reducing body immunity and increasing the risk of infections and other complications.[35] The substantial incidence rate of postoperative psychological dysfunction highlights a significant unmet need in routine postoperative care, indicating that systematic screening and early psychological intervention should be urgently integrated into standard clinical management. Therefore, the construction of a prediction model for postoperative psychological dysfunction in breast cancer patients with fear of disease is very necessary, and the early identification of high-risk individuals will facilitate targeted intervention and prevent the deterioration of psychological function. Thus, such a model will be helpful for clinical decision-making, such as the selection of treatment plans and resource allocation, to improve the quality of life and rehabilitation of patients.

Breast Cancer Patients with Total Resection are More Likely to Develop Psychological Dysfunction

This study showed that total resection was a risk factor for psychological dysfunction in breast cancer patients with postoperative fear of disease, which is contrary to the study by Zhang and Duan.[14] This discrepancy may be explained by assessment timing: our study captured patients' acute distress on postoperative day 2. In contrast, the above study assessed rehabilitated patients who had adapted over time. The physical condition of the patients at this stage is improved; therefore, the psychological burden is lighter. Moreover, increased engagement with fellow patients during rehabilitation exerted positive psychosocial effects, which contributed to a lower incidence of psychological distress. In addition, patients with total resection have drainage tubes at the time of discharge, which impacts their daily activities of life. Additionally, the change in body image causes them to have negative emotions such as low self-esteem and anxiety.[36] Patients may also worry about postoperative problems such as socializing. Therefore, health educators should offer psychological guidance to patients and convey to them the concept of positive social support; for patients who opt for prosthetic implants, objective information should be provided to inform them of the risks and benefits. Tauber et al[37] further confirmed that professional psychological intervention can significantly improve patients' psychological function and reduce the severity of psychological problems. On this basis, clinical psychologists should conduct comprehensive systematic health education to minimize patients' psychological dysfunction and improve their quality of life.

Breast Cancer Patients with a Higher Education Level Have a Lower Risk of Psychological Dysfunction

This study found that education level was an influencing factor for psychological dysfunction in patients with fear of disease after breast cancer surgery, which is consistent with the results of Fang et al.[38] Education level is closely related to cognitive ability. Patients with a high education level have a high level of knowledge and comprehension, and can effectively obtain answers to their questions through the internet and other ways, which may explain why their psychological status is better. Relevant studies have shown that intervention for patients' partners can improve the psychological condition of the patients, as the close relations, attitude, and support have a profound impact on the psychological status of patients.[39] Therefore, during the treatment process, it is necessary to explain the information about breast cancer to patients with different education levels according to their individual understanding ability. For

patients with low education level, easy-to-understand forms such as pictures and videos should be used to explain the surgical procedure and postoperative recovery. For the patient's partner, supportive intervention should be carried out to encourage them to actively participate in patient care and psychological support, such as teaching the partner to express emotional support correctly, avoid hurtful language, and enhance the patient's self-confidence.

Patients with Higher Quality of Life and Less Fear of Cancer Recurrence Tend to Have Better Psychological Health

This pioneering study presents the first prediction model specifically for psychological dysfunction in breast cancer patients with postoperative fear of disease. Although direct comparison with existing models is not possible due to the absence of similar tools, the model demonstrates strong discriminative power (AUC = 0.860) and robustness (bootstrapped AUC = 0.851), supporting its value in addressing an unmet clinical need for the early identification of psychological dysfunction after breast cancer surgery. Future research should focus on external validation and comparative studies with future models.

Fear of cancer recurrence refers to the psychological state of patients who are afraid of cancer recurrence, progression, or metastasis.[40] In this study, the total quality-of-life score of postoperative breast cancer patients was 96.57 ± 12.22, and the total score of fear of cancer recurrence was 13.31 ± 6.01. Both were influencing factors for psychological dysfunction in patients with fear of disease. The fear of cancer recurrence is different from the fear of disease progression. The former is the patient's concern about the recurrence of cancer after treatment, which focuses on the problem of cancer recurrence and mostly occurs in the rehabilitation or follow-up stage after treatment. The latter has a broader meaning, covering the fear of cancer recurrence and the worry of adverse conditions during the development of the disease, such as a decline in physical function and an increase in complications caused by cancer metastasis; this type of fear occurs throughout the clinical course after cancer diagnosis.[41,42] In this study, the higher the quality-of-life score and lower the fear of cancer recurrence score, the healthier the mental state of cancer patients. Quality of life is closely related to the functional recovery of the ipsilateral limb after surgery. The closer the functional recovery of the affected limb is to normal, the higher the social value of the patient.[43] Regarding tool selection, our multivariate analysis revealed that the FCRI-SF provided stronger predictive value for psychological dysfunction than the broader FoP-Q-SF in this postoperative setting. Studies have shown that exercise can improve patients' psychological state.[44] In addition, encouraging patients to participate in social activities can disperse their attention from concerns about cancer and reduce excessive thinking about cancer recurrence, forming a virtuous cycle that improves the body's recovery and quality of life. Therefore, medical staff should guide patients to adjust their lifestyle, regularly work and rest, guide psychological reconstruction, encourage social activities, and explain to patients the purpose and process of regular review, so that patients understand that review is a key means to monitor their physical condition and detect problems early.

Conclusion

This study provides novel insights by being the first to develop and internally validate a risk-prediction model for psychological dysfunction specifically in breast cancer patients experiencing postoperative fear of disease, a high-risk yet understudied population in China. The incidence of psychological dysfunction in breast cancer patients with postoperative fear of disease is 37.1%, which is affected by many factors such as surgical method, education level, postoperative quality of life, and fear of cancer recurrence. The prediction model for psychological dysfunction in patients with fear of disease after breast cancer surgery constructed in this study has high discrimination and accuracy, and can be used by clinical medical staff to accurately evaluate and predict the psychological state of patients. On the basis of our findings, we recommend the following structured interventions for high-risk patients: (1) For patients with low education levels, provide personalized health education using easy-to-understand formats such as pictures and videos. (2) For patients who have undergone total mastectomy, focus on body image concerns, provide information on prostheses or reconstructive surgery early, and guide them to build positive social support systems. (3) Integrate screening for fear of progression/recurrence into routine care, and offer psychological interventions (eg, cognitive behavioral therapy or mindfulness-based stress reduction) to those with high fear. (4) Encourage patients to participate

in rehabilitative exercises and social activities to improve their quality of life and psychological state by enhancing functional recovery and distraction.

This study has several limitations. First, the risk-prediction model lacked external validation, which may affect its generalizability to other populations. Second, as our study focused on the immediate postoperative period, we did not account for the potential dynamic changes in psychological state over time. Mental state is a fluid phenomenon that may evolve during recovery and throughout subsequent treatment phases. Third, our findings are based on a specific patient population that had not undergone neoadjuvant therapy, which may limit the applicability of our results to breast cancer patients receiving multimodal treatment. Fourthly, the use of convenience sampling from a single center may limit the generalizability of our findings. Future studies should include external validation of the prediction model, longitudinal assessment of psychological states at multiple time points, investigation of psychological responses throughout the entire treatment process (including during and after neoadjuvant and adjuvant therapy), and multi-center random sampling.

Data Sharing Statement

The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

Ethics Approval and Informed Consent

This study was approved by the Ethics Committee of The First Affiliated Hospital with Nanjing Medical University (approval code: 2023-SR-770) and was performed in compliance with the Declaration of Helsinki. All subjects provided written informed consent.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article, gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no competing interests in this work.

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