

ORIGINAL RESEARCH ARTICLE

Relationship between health belief levels and fear of cancer recurrence in breast cancer patients: Development of a predictive model

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Abstract

This study examines the relationship between health beliefs and fear of cancer recurrence among breast cancer (BC) patients and develops a predictive model for cancer recurrence fear. A total of 120 patients from the Breast Surgery Department of a top tertiary hospital, spanning December 2022 to December 2023, were included in the study. Data were collected using general information questionnaires, Champion's Health Belief Model Scale (CHBMS) and the Fear of Progression Questionnaire-Short Form (FoP-Q-SF). The analysis revealed that CHBMS and FoP-Q-SF scale scores of BC patients were 94.17 ± 15.59 points and 34.90 ± 7.15 points, respectively. The total CHBMS score, perceived benefits, health motivation, and self-efficacy were negatively correlated with the total FoP-Q-SF score and its dimension scores ($P < 0.05$), whereas perceived severity, perceived susceptibility, type of operation, radiotherapy and chemotherapy treatment, and perceived barriers showed a positive correlation ($P < 0.05$). Significant differences in FoP-Q-SF scores were observed among patients of different ages, marital statuses, education levels, average monthly household incomes, levels of family caregiving, tumor node metastasis (TNM) stages, and types of medical insurance ($P < 0.05$). Multivariate logistic regression analysis identified age, marital status, education level, average monthly household income, family caregiving, TNM stage, chemoradiotherapy treatment, and CHBMS scale scores as significant factors influencing cancer recurrence fear ($P < 0.05$). A predictive model regression equation was established, and the model's area under the ROC curve was 0.759 (95% confidence interval = 0.702 – 0.834, $P < 0.001$). Patients aged 50 years and older exhibited higher fear levels. This fear is also affected by age, marital status, education level, average monthly household income, family caregiving, TNM stage, and chemoradiotherapy treatment. The predictive model based on these factors demonstrates good predictive efficacy for cancer recurrence fear, providing a basis for early identification of high-risk patients and targeted nursing interventions.

Keywords: Breast cancer; Health belief; Cancer recurrence fear; Predictive model; Nursing***Corresponding author:**Liping Cui
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Citation: Yu Z, Wang L, Song B, Cui L. Relationship between health belief levels and fear of cancer recurrence in breast cancer patients: Development of a predictive model. *Cancer Plus*. 2024;6(3):4062.
doi: 10.36922/cp.4062

Received: June 27, 2024**Accepted:** August 7, 2024**Published Online:** September 23, 2024

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1. Introduction

Breast cancer (BC) is one of the most common malignant tumors among women worldwide, with high incidence and mortality rates.¹ As of 2020, the incidence rate of BC among Chinese women was 59.0/100,000, and the mortality rate was 16.6/100,000,

making it the most prevalent cancer and the fourth leading cause of cancer-related deaths among women, posing a serious threat to their physical and mental health.² Recurrence and metastasis are common causes of death in BC patients.³

With advancements in medical technology, early detection and treatment methods for BC have improved, significantly increasing patient survival rates. However, many patients generally experience a significant fear of cancer recurrence. Statistics show that the incidence of fear of cancer recurrence after BC surgery is as high as 68.42%, severely affecting patients' quality of life and social functioning.⁴ Cancer patients report declines in physical functioning, increased pain, and generally reduced quality of life.⁵ This can reduce compliance with oncologic treatment, leading to adverse consequences for cancer prognosis and mortality.

Diet has been shown to improve the quality of life in BC survivors,⁶ and greater adherence to the Mediterranean diet has been associated with better physical functioning and health status in women recently diagnosed with BC.⁷ Health beliefs refer to an individual's attitudes and views toward health behaviors, which directly influence their health decisions and behavior patterns.⁸ The level of health beliefs in BC patients may directly impact their attitude toward the disease, their willingness for self-care, and their psychological adjustment ability in the face of cancer recurrence fear.

Therefore, exploring and clarifying the relationship between patients' health beliefs and their fear of cancer recurrence are crucial for developing targeted nursing strategies to alleviate their fear and improve their quality of life. At present, there is a lack of research on the correlation between health belief levels and fear of cancer recurrence in BC patients. Based on this, this paper aims to investigate the relationship between health belief levels and fear of cancer recurrence in BC patients and to construct a predictive model to provide a reference for psychological health-care interventions for BC patients.

2. Materials and methods

2.1. General information

This study utilized a cross-sectional survey design and was approved by the Ethics Committee of Shanxi Bethune Hospital (No. SBQKL-2023-110). Ethical considerations, including obtaining informed consent and ensuring data confidentiality, were strictly followed throughout the data collection and analysis process. The sample size was determined based on the Champion Health Belief Model Scale (CHBMS), which has six dimensions. Using

a rule of thumb of 10 – 20 participants per dimension, the initial target was set at 120 participants. To account for potential invalid responses, the sample size was increased by 10%, leading to a final target of 132 participants. After distributing the questionnaires, 129 responses were collected. Following the exclusion of nine invalid questionnaires, the final sample size comprised 120 BC patients hospitalized in the Breast Surgery Department of a tertiary hospital from December 2022 to December 2023.

Inclusion criteria included (i) patients meeting the diagnostic criteria for BC,⁹ confirmed by pathology, who have undergone surgery and chemo/radiotherapy; (ii) age ≥ 18 years; (iii) disease duration of ≥ 6 months; (iv) clear consciousness with normal reading and expression abilities; and (v) informed consent and ability to complete the questionnaire.

Exclusion criteria were (i) patients with other systemic malignancies; (ii) patients with severe diseases in vital organs such as the heart, liver, and kidneys; (iii) patients with a history of psychological disorders or cognitive impairments; and (iv) patients with distant metastases or recurrent BC.

2.2. Survey tools

2.2.1. General information questionnaire

A self-designed questionnaire was utilized to collect data on the patient's age, duration of illness, marital status, education level, average monthly household income, family caregiving, employment status, TNM stage, and medical insurance. In addition, the types of surgery, radiotherapy and chemotherapy treatment, and social support were sorted out. The study adopted the social support rate scale compiled by Liu *et al.*,¹⁰ which includes 10 items across three dimensions: Subjective support, objective support, and support utilization. Higher scores indicate a higher degree of social support. It is generally believed that a total score of <20 indicates low social support, 20 – 30 indicates a general degree of social support, and 30 – 40 indicates a satisfactory degree of social support. The retest reliability r of this scale was 0.92, and Cronbach's α coefficient ranged from 0.89 to 0.94.

2.2.2. Health beliefs

The CHBMS was used to evaluate patients' health beliefs. This scale, originally developed by Champion,¹¹ was revised by Fengjuan¹² for use with BC patients in China. The revised scale includes perceived severity (6 items), perceived susceptibility (4 items), perceived benefits (3 items), perceived barriers (5 items), health motivation (7 items), and self-efficacy (4 items). Each item is scored on a Likert scale from 1 to 5, with total scores ranging from 29

to 145. Scores below 67 indicate low health beliefs, scores between 68 and 106 indicate moderate health beliefs, and scores of 107 and above indicate high health beliefs. Higher scores reflect stronger health beliefs and a greater willingness to adopt healthy behaviors. The Cronbach's α coefficient for the scale ranges from 0.83 to 0.93.

2.2.3. Fear of cancer recurrence

The Fear of Progression Questionnaire-Short Form (FoP-Q-SF) was utilized to evaluate the degree of fear related to cancer recurrence among patients. This scale, originally developed by Luz *et al.*,¹³ was translated and adapted into Chinese by Wu *et al.*¹⁴ It includes 12 items across two dimensions: physical health and social/family concerns. Each item is rated on a Likert 5-point scale, with total scores ranging from 12 to 60. Higher scores reflect a higher level of fear regarding cancer recurrence. Scores of 34 or above indicate psychological dysfunction. The Cronbach's α coefficient for this scale is 0.883.

2.2.4. Survey method

After the study was approved by the Ethics Committee of the hospital, a questionnaire survey was conducted on the enrolled patients according to the inclusion and exclusion criteria. The researchers for this survey were all nurses with the title of supervisor or above. Before the study commenced, standardized training was conducted for the nurses participating in the survey. After the questionnaires were distributed, the purpose of the survey and the requirements for completing the questionnaire were explained to the patients under unified guidance. Patients were informed that this was an anonymous questionnaire survey to ensure the privacy of their information, and consent was obtained to collect accurate data. Patients were also advised to consult the investigators if they did not understand any items during the questionnaire process. The questionnaires were issued and checked on the spot, and any missing items were completed immediately. After the questionnaires were collected, they were verified against the patient's medical records and reexamination results to reduce data bias. A total of 132 questionnaires were distributed, and 120 were effectively recovered, resulting in an effective recovery rate of 90.91%.

2.2.5. Statistical methods

The collected data were processed using the Statistical Package for the Social Sciences 24.0 software. Measurement data following a normal distribution (mean \pm standard deviation) were analyzed using *t*-tests, while categorical data (*n* [%]) were analyzed using Chi-squared (χ^2) tests. Pearson correlation coefficients were used to examine the relationship between patients' health belief levels and their

fear of cancer recurrence. Multivariate logistic regression analysis was employed to identify factors influencing the fear of cancer recurrence. A $P < 0.05$ was considered statistically significant.

3. Results

3.1. Health belief scores and fear of cancer recurrence scores in BC patients

The CHBMS and FoP-Q-SF scores among BC patients were 94.17 ± 15.59 and 34.90 ± 7.15 , respectively. Detailed scores are presented in Table 1.

3.2. Correlation between health beliefs and fear of cancer recurrence in BC patients

There was a negative correlation between the total score of the CHBMS, perceived benefits, health motivation, and self-efficacy, and the total score of the FoP-Q-SF scale, as well as the physical health and social/family dimensions ($P < 0.05$). Conversely, perceived severity, perceived susceptibility, and perceived barriers showed a positive correlation with the total score of the FoP-Q-SF scale and the physical health and social/family dimensions ($P < 0.05$). Detailed correlations are presented in Table 2.

3.3. Comparison of fear of cancer recurrence scores among BC patients with different demographic characteristics and treatment

The comparison of FoP-Q-SF scores among BC patients across different age groups, marital statuses, education levels, average monthly household incomes, family caregiving situations, TNM stages, type of operation and chemoradiotherapy, and types of medical insurance revealed statistically significant differences ($P < 0.05$).

Table 1. Total and dimension scores of health belief and fear of cancer recurrence in breast cancer patients

Scale	Items	Score range	Average score
Champion Health Belief model scale	29	29 – 145	94.17 \pm 15.59
Perceived severity	6	6 – 30	18.43 \pm 5.33
Perceived susceptibility	4	4 – 20	11.94 \pm 3.24
Perceived benefits	3	3 – 15	12.42 \pm 2.16
Perceived barriers	5	5 – 25	13.84 \pm 2.25
Health motivation	7	7 – 35	23.01 \pm 6.94
Self-efficacy	4	4 – 20	14.53 \pm 2.87
Fear of Progression Questionnaire-Short Form	12	12 – 60	34.90 \pm 7.15
Physical health	6	6 – 30	18.23 \pm 3.20
Social/family	6	6 – 30	16.67 \pm 5.28

Table 2. Correlation between health beliefs and fear of cancer recurrence in breast cancer patients

FoP-Q-SF	Health beliefs						Total score
	Perceived severity	Perceived susceptibility	Perceived benefits	Perceived barriers	Health motivation	Self-efficacy	
Total score							
<i>r</i>	0.457	0.414	−0.397	0.577	−0.503	−0.478	−0.563
<i>P</i>	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Physical health							
<i>r</i>	0.413	0.325	−0.385	0.489	−0.487	−0.492	−0.538
<i>P</i>	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Social/family							
<i>r</i>	0.425	0.382	−0.402	0.591	−0.511	−0.455	−0.697
<i>P</i>	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

However, the comparison of FoP-Q-SF scores among patients with different disease durations and employment statuses showed no statistically significant differences ($P > 0.05$). Detailed results are presented in Table 3.

3.4. Multivariate logistic regression analysis of factors influencing fear of cancer recurrence in BC patients

The 10 independent variables with statistical significance in Tables 2 and 3 were included in the multicollinearity analysis. The variance inflation factor of the independent variables was all < 5 , and the tolerance was > 0.2 , indicating that there was no significant multicollinearity problem. With FoP-Q-SF score as the dependent variable, age, marital status, education level, average monthly household income, family caregiving, TNM stage, medical insurance, type of surgery, chemoradiotherapy treatment, and CHBMS score in Table 3 as independent variables were included in multivariate logistic regression analysis, and the assignment of independent variables is shown in Table 4. The results showed that age, marital status, education level, average monthly household income, family caregiving, TNM stage, chemoradiotherapy, and CHBMS scale score were all influencing factors for the fear of cancer recurrence in BC patients ($P < 0.05$), as shown in Table 5.

3.5. Construction of a predictive model for fear of cancer recurrence in BC patients

Based on the logistic regression analysis of factors influencing fear of cancer recurrence in BC patients, the predictive model regression equation is as follows:

$$Y = \ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_m X_m \quad (I)$$

The regression equation of the prediction model was constructed as follows:

$$Y = 32.425 - 4.537 \times \text{age} + 1.920 \times \text{marital status} + 1.532 \times \text{education level} - 2.482 \times \text{average monthly household income} + 2.013 \times \text{family caregiving} + 3.982 \times \text{TNM stage} + 2.094 \times \text{chemoradiotherapy} - 5.963 \times \text{CHBMS score} \quad (II)$$

The ROC curve of this prediction model is shown in Figure 1. The area under the ROC curve (AUC) of the prediction model was 0.759 (95% confidence interval [CI] = 0.702 – 0.834, $P < 0.001$), which showed good prediction efficiency.

4. Discussion

Fear of cancer recurrence refers to the worry and anxiety individuals experience regarding the potential return or progress of their cancer, making it one of the most common psychological issues among cancer patients.¹⁵ This fear persists throughout a patient's life, from diagnosis to treatment and beyond, representing a chronic psychological burden.¹⁶ The results of this study show that the FoP-Q-SF scale score for the 120 BC patients included in the study was 34.90 ± 7.15 , indicating a moderate level of fear of cancer recurrence. BC patients often harbor significant concerns and fears about the recurrence of their disease, which is a key focus in clinical care due to the high risk of recurrence and metastasis. In cancer rehabilitation, targeted nursing interventions can provide comprehensive psychological support, promote social interaction, enhance self-efficacy, effectively reduce the fear of cancer recurrence, and improve patients' quality of life and mental health. In clinical nursing, it is important to address patients' health beliefs and help them establish positive health beliefs through information support and psychological counseling.

In this study, the health belief score of BC patients was 94.17 ± 15.59 , and it was significantly correlated with fear of cancer recurrence ($P < 0.05$). The total score of the

Table 3. Comparison of fear of cancer recurrence scores among breast cancer patients with different demographic characteristics and treatment

Demographic characteristics	Number of cases	FoP-Q-SF score	<i>t/F</i>	<i>P</i>
Age (years)			5.877	<0.001
≤50	63	38.25±5.52		
>50	57	31.20±7.55		
Disease duration (months)	49	35.21±6.73	0.399	0.691
≤12				
>12	71	34.69±7.22		
Marital status			5.783	<0.001
Married	102	33.65±5.01		
Unmarried, divorced, or widowed	18	41.98±8.44		
Education level			2.144	0.034
Junior high school or below	86	34.07±6.63		
High school or above	34	37.00±7.04		
Average monthly household income (RMB)			3.859	< 0.001
<3000	38	38.55±4.30		
3000 – 5000	49	32.51±8.05		
>5000	33	34.24±7.91		
Family caregiving			4.385	<0.001
Children or spouse	106	33.91±6.78		
Parents or no caregivers	14	42.40±7.03		
Employment status			0.862	0.391
Employed	88	35.21±6.48		
Unemployed	32	34.05±6.64		
Occupational status			0.862	0.391
Active personnel	88	35.21±6.48		
Non-active personnel	32	34.05±6.64		
TNM stage			7.478	<0.001
I – II	83	32.45±4.09		
III – IV	37	40.40±7.53		
Medical insurance			2.161	0.033
Yes	104	34.35±7.44		
No	16	38.48±4.27		
Type of operation			2.151	0.034
Breast-conserving surgery	22	37.46±5.36		
Non-breast-conserving surgery	98	34.33±6.33		
Chemoradiotherapy			3.096	0.003
Yes	102	35.47±4.20		
No	18	31.67±7.43		
Social support			1.083	0.210
<20	8	34.89±5.37		
20 – 30	58	35.02±5.36		
>30	54	35.17±6.34		

Table 4. Assignment of values to independent variables

Variable	Assignment
Age	≤50=1; >50=2
Marital status	Married=1; Unmarried, divorced, or widowed=2
Education level	Junior high school or below=1; High school or above=2
Average monthly household income	<3000=1; 3000 – 5000=2; >5000=3
Family caregiving	Children or spouse=1; Parents or no caregiver=2
TNM stage	Stage I – II=1; Stage III – IV=2
Medical insurance	Yes=1; No=2
Type of operation	Non-breast-conserving surgery=1; Breast-conserving surgery=2
Chemoradiotherapy	Yes=1; No=2
CHBMS score	Original value

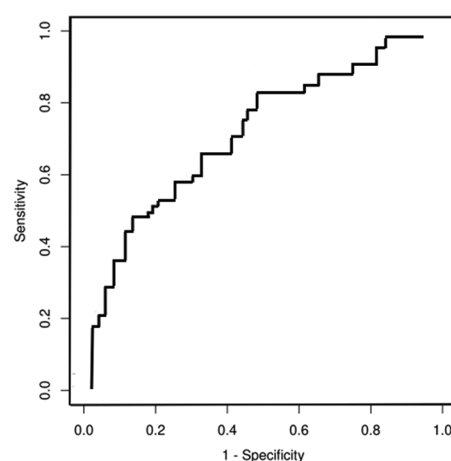
Abbreviation: CHBMS: Champion's health belief model scale.

Table 5. Logistic regression analysis of factors influencing fear of cancer recurrence in breast cancer patients

Independent variable	B	SE	β	t	P
Constant	32.425	3.673	-	8.964	<0.001
Age	-4.537	1.284	-0.284	-3.640	<0.01
Marital status	1.920	0.804	0.142	2.843	<0.01
Education level	1.532	0.945	0.241	3.002	<0.01
Average monthly household income	-2.482	0.503	-0.211	5.630	<0.001
Family caregiving	2.013	0.933	0.175	3.202	<0.01
TNM stage	3.982	0.854	0.283	6.426	<0.001
Chemoradiotherapy	2.094	0.572	0.225	5.593	<0.001
CHBMS score	-5.963	0.895	-0.327	7.281	<0.001

Abbreviation: CHBMS: Champion's health belief model scale.

health belief scale, perceived benefits, health motivation, and self-efficacy was negatively correlated with fear of cancer recurrence ($P < 0.05$). This suggests that the higher the patient's perception of the benefits of their treatment, health motivation, and self-efficacy, the lower their fear of cancer recurrence. Conversely, perceived severity, perceived susceptibility, and perceived barriers were positively correlated with fear of cancer recurrence ($P < 0.05$), indicating that the more concerned patients were about the severity of their disease, their susceptibility, or treatment barriers, the higher their fear of cancer recurrence. Therefore, in clinical care, it is essential to consider patients' health belief levels and assist them in establishing positive health beliefs through information support and psychological counseling.

**Figure 1.** Receiver operator characteristic curve of the predictive model for fear of cancer recurrence in breast cancer patients

This study compared the fear of cancer recurrence scores among BC patients with different demographic characteristics. The FoP-Q-SF scale scores differed significantly among patients based on age, marital status, education level, average monthly household income, family caregiving situation, TNM stage, and medical insurance status ($P < 0.05$). Multivariate logistic regression analysis indicated that age, marital status, education level, average monthly household income, presence of family caregiving, TNM stage, and CHBMS scale score are all significant factors influencing the fear of cancer recurrence in BC patients ($P < 0.05$). (i) Patients aged ≤50 years have higher levels of fear of cancer recurrence. Younger patients are more impacted by a BC diagnosis due to greater family and work pressures, higher economic burdens, and higher self-image demands, which can negatively affect their self-esteem and exacerbate their fear of cancer recurrence.^{17,18} (ii) Patients who are unmarried, divorced, or widowed have higher levels of fear of cancer recurrence. Married patients benefit from emotional support and care from their spouses, which helps alleviate psychological pressure and reduce their fear of cancer recurrence. In contrast, those who are unmarried, divorced, or widowed lack such support, leading to greater feelings of loneliness and insecurity, and subsequently, a higher fear of cancer recurrence.¹⁹ (iii) Patients with a high school education or above have higher levels of fear of cancer recurrence. Higher education levels enable patients to access more information about their disease, increasing their vigilance and concern about the possibility of cancer recurrence. In addition, these patients may have higher expectations for their health and face greater social pressures, which can lead to increased fear of cancer recurrence. (iv) Patients with lower average monthly household incomes have

higher levels of fear of cancer recurrence. Economic pressures and insufficient resources to cope with cancer recurrence contribute to a greater psychological burden and negative emotions, thereby increasing their fear of cancer recurrence.^{20,21} (v) Patients cared for by parents or without caregivers have higher levels of fear of cancer recurrence. Feelings of guilt toward elderly parents or the loneliness and helplessness of having no caregivers can increase the psychological burden for these patients, leading to a higher fear of cancer recurrence. (vi) Patients with TNM Stage III – IV have higher levels of fear of cancer recurrence. A more advanced disease stage, with greater treatment difficulty and higher recurrence risk, creates significant psychological pressure and uncertainty about future treatment, contributing to a higher fear of cancer recurrence.²² (vii) Higher CHBMS health belief scores are associated with lower levels of fear of cancer recurrence. Health beliefs are fundamental to patients' health-promoting behaviors, significantly influencing their treatment attitudes, behaviors, and psychological states. (viii) The fear of cancer recurrence was higher in patients treated with chemoradiotherapy. During radiotherapy and chemotherapy, patients may experience physiological symptoms such as severe vomiting and insomnia, coupled with negative psychological emotions such as anxiety and depression, which may aggravate the fear of cancer recurrence. Higher health belief levels indicate a richer understanding of health, clearer disease cognition, and a more positive approach to facing the disease, thereby reducing unnecessary fears.²³⁻²⁵ The CHBMS scale was selected for health belief assessment in this study because it had been validated in Chinese for BC patients, making it consistent with the study's objectives. However, further expert consultation, scale localization, and adaptive modifications will be necessary for future research. The scale will also need to be revised and verified through pre-testing.

Based on the results of logistic regression analysis, the regression equation for the prediction model of fear of cancer recurrence in BC patients was constructed (Equation II). The AUC of this prediction model was 0.759 (95% CI = 0.702 – 0.834, $P < 0.001$), indicating good prediction efficiency. This model provides a tool to evaluate the fear of cancer recurrence in BC patients and offers a scientific basis for developing personalized psychological intervention measures.

In conclusion, there is a significant correlation between health belief levels and fear of cancer recurrence in BC patients. The construction of a predictive model for fear of cancer recurrence based on multivariate logistic regression analysis provides a scientific basis for predicting

cancer recurrence fear and formulating psychological care interventions. However, this study has some limitations. First, being cross-sectional, this study cannot establish a causal relationship between levels of health beliefs and fear of cancer recurrence in BC patients. Second, due to the timing of data collection, the study did not explore how health beliefs affect patients' fear of cancer recurrence over time. Future research could use a longitudinal design to further explore the causal and dynamic relationships between these variables. In addition, this study included only a small number of patients from one hospital, resulting in a limited sample size and regional scope. Expanding the research to include BC patients in outpatient settings and other hospitals could reduce research bias. Furthermore, the study found that factors not included in the initial analysis, such as daily functional ability, hospice care preferences, palliative care choices, and community resource support, may impact patients' fear of cancer recurrence. Daily functional ability may indirectly affect fear levels by influencing patients' psychological states. Fear of cancer recurrence could also impact end-of-life care preferences and willingness to accept palliative care, both of which may affect fear levels through emotional support, spiritual comfort, and symptom improvement. Moreover, patients are exposed to social and financial support from community resources, which may also influence their fear levels. These factors could be further explored in subsequent research.

5. Conclusion

The predictive model based on these factors demonstrates good predictive efficacy for cancer recurrence fear, providing a basis for early identification of high-risk patients and targeted nursing interventions.

Acknowledgments

None.

Funding

None.

Conflict of interest

The authors declare that they have no competing interests.

Author contributions

Conceptualization: All authors

Investigation: All authors

Methodology: All authors

Writing-original draft: All authors

Writing-review & editing: All authors

Ethics approval and consent to participate

This project was approved by the Shanxi Bethune Hospital Committee (NO.SBQKL-2023-110). Informed consent was obtained from study subjects before participating in the study.

Consent for publication

The study subjects gave consent to publish their data in this study.

Availability of data

Data used in this work are available from the corresponding author on reasonable request.

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