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Original Article

Validation and application of the breast cancer distress thermometer in Chinese patients: Cutoff scores and stage-specific manifestations

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ABSTRACT

Objective: The first aim was to update and revise the Distress Thermometer (DT) to enhance its applicability in breast cancer patients. The second aim was to define the cutoff scores of the Breast Cancer Distress Thermometer (DT-BC) and identify the prevalence and manifestations of distress across different stages of the disease.
Methods: The DT-BC was updated according to the Distress Management Guidelines from NCCN, Version 3.2019, and revised through a literature review, expert consultation, and patient surveys. Reliability was assessed using reliability analysis, test-retest reliability, and Kappa value; validity was tested via content and criterion-related validity. The cutoff scores of DT-BC were determined using the Hospital Anxiety and Depression Scale and receiver operating characteristic (ROC) curve analysis. Sensitivity and specificity were calculated based on the area under the curve (AUC). Nonparametric tests and logistic regression were used to analyze distress manifestations.
Results: The total Cronbach's α for the problem list was 0.805, and the test-retest reliability coefficient was 0.750, with a Kappa value of 0.458. The content validity index was 1.00, and the criterion-related validity coefficient was 0.476. The DT-BC cutoff score was 6 for the diagnostic and postoperative treatment stages, 5 for the neoadjuvant and postoperative stages, and 4 for the rehabilitation stage. The prevalence and manifestations of distress varied significantly across different stages, with emotional distress being a common manifestation throughout the disease process.
Conclusions: Based on the results of this psychometric evaluation, the DT-BC is considered suitable for use in the routine psychological screening of breast cancer patients.

Introduction

According to the Global Cancer Data for 2022 released by the International Agency for Research on Cancer, breast cancer is the most prevalent malignancy among women worldwide. In Chinese women, it remains the second most common cancer.[1] Patients with breast cancer experience a severe mental burden due to diagnosis, treatment, and emotional distress.[2] As the sixth vital sign after pain, distress is widespread in patients with breast cancer.[3]

Distress is a multifactorial, unpleasant experience of a psychological (cognitive, behavioral, emotional), social, spiritual, and physical nature.[4] It may affect the ability of patients with cancer to cope effectively with physical symptoms and treatment. The prevalence of distress in patients with breast cancer varied from 39% to 52%.[3,5,6] Specifically, in China, this prevalence is 42.3%.[7] Therefore, the National Comprehensive Cancer Network (NCCN) recommends timely evaluation and screening of distress using practical tools.[4]

The Distress Thermometer (DT) is a short screening tool recommended by the NCCN to assess distress. It includes a thermometer and problem lists (PL).[8] It has been translated into many languages and is widely used in different populations. Tang et al. translated the DT into Chinese in 2010, supporting its applicability to Chinese patients with cancer.[9] However, with the update of Distress Management, the Chinese version of the DT has not been updated in time. Meanwhile, we conducted

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a pre-experiment on breast cancer patients using the DT and PL recommended by *Distress Management, Version 3.2019*. We discovered that the new version of the DT was not very applicable to breast cancer patients and did not fully capture their psychological distress. Therefore, to more accurately identify the psychological distress of breast cancer patients in China, it is necessary to update and revise the Chinese version of the DT.

The NCCN recommends an optimal cutoff score of four for screening distress. Consistent with this, the optimal cutoff score among Asian cancer patients is four.[10] And it is also four in China.[9] However, the cutoff score is six in Palestine and three in the United States.[11,12] Therefore, it can be observed that the cutoff score varies among different countries. In addition, the cutoff score varies across different treatment stages. For instance, nasopharyngeal cancer patients might attain a score of four during the treatment phase,[13] yet this score may not be replicated at the rehabilitation stage.[14] Therefore, it is necessary to explore the cutoff score for different stages of breast cancer within the context of Chinese culture.

Studies have found that the manifestations of distress in patients with breast cancer at the diagnosis, treatment, and rehabilitation stages are different.[15] For example, the manifestations for newly diagnosed patients are insurance/financial distress.[16] However, those for chemotherapy patients include physical problems such as physical activity and fatigue.[17] Therefore, screening patients with breast cancer according to the cutoff scores of different stages can improve accuracy. Furthermore, targeted interventions can be provided to relieve psychological distress in patients with breast cancer based on the problems listed in the PL at different stages.

In summary, the objectives of this study were: (1) to update and revise the Chinese version of the DT to make it more suitable for patients with breast cancer; (2) to define the optimal cutoff scores for the Breast Cancer Version of the DT during the diagnosis, treatment, and rehabilitation stages; (3) to identify the prevalence and manifestations of distress at each stage.

Methods

Step I

Step I involved updating and revising the DT for breast cancer (DT-BC) (Supplementary Fig. S1).

Update

The PL of the original Chinese version of the scale was updated according to Distress Management, 2019 (Supplementary Table S1), with consent from the original author of the Chinese version of the DT.[9]

Revision

Pre-survey. Thirty-three inpatients with breast cancer were selected via convenience sampling to complete a one-to-one questionnaire to assess its appropriateness and comprehensibility. During the investigation, the following issues were noted: (1) patients could not subjectively evaluate their psychological pain level; (2) some items in the PL, such as 'sexual' and 'substance use' listed under physical problems could not be understood; and (3) patients faced other problems outside the list.

Expert consultation. Three clinical experts and six nursing experts were invited to evaluate the clarity and intelligibility of the questionnaire items. The expert information is detailed in Supplementary Table S2.

Initial revision. A visual analog scale was combined with a single thermometer, and some items in the PL were modified according to the questions posed by patients with breast cancer and expert suggestions. In addition, the symptoms of patients with breast cancer during the treatment process, excluding those in the PL, were supplemented by referring to the literature and consulting with experts.

Preliminary test of the scale. Convenience sampling was used to select 20 patients with breast cancer who underwent breast surgery at a tertiary hospital in Shijiazhuang to complete the questionnaire. During the process, the patients' reactions were observed, and they were instructed to use a three-point system (easy to understand, medium, and difficult to understand) to judge the difficulty of understanding the questionnaire items. Based on a preliminary test, the format and content of the scale were revised to finalize the DT-BC.

Steps II and III

Step II involved examining the psychometric properties of DT-BC. Step III included determining the cutoff scores and identifying the prevalence and manifestations of distress at different stages of breast cancer (Supplementary Fig. S1).

Design and participants

In this multicenter, cross-sectional study, convenience sampling was used to investigate patients admitted to the Department of Breast Cancer of two hospitals in Hebei Province from March 2021 to September 2021.

The inclusion criteria for patients were as follows: (1) pathologically diagnosed breast cancer, (2) age $\geq$ 18 years, (3) clear awareness and understanding of the survey content, and (4) informed consent and voluntary participation.

The exclusion criteria were as follows: (1) other concomitant malignant tumors, (2) inability to communicate due to intellectual or mental factors, and (3) written or oral communication barriers.

To ensure research quality and maintain consistency across both hospitals, we established a comprehensive quality control plan. This included thorough training and supervision of data collectors, a pilot test to refine the data collection instruments, and regular inter-hospital meetings to align procedures.

Sample size

Step II: According to the principle that the minimum sample size should be 5 to 10 times the number of items,[18] there are a total of 37 items in the questionnaire for this study, so the sample size $n = 185$ to 370. Considering invalid and lost-to-follow-up cases, the sample size is increased by 20%. Therefore, the final determined sample size $n = 444$.

Step III: The sample size was calculated using MedCalc software based on the area under the receiver operating characteristic (ROC) curve (AUC) for DT with Hospital Anxiety and Depression Scale (HADS) as the gold standard, which ranges from 0.81 to 0.85 in the literature. The minimum allowable AUC was set at 0.75, with an α value of 0.05, a β value of 0.10, and a sampling size ratio of 1.00 for negative/positive groups, resulting in an initial sample size of 50. Considering factors such as invalid questionnaires and dropouts, the sample size was increased by 20%, leading to a final sample size of 60 cases for each stage, totaling 300 cases.

Measures

Distress thermometer for breast cancer (DT-BC). The DT-BC is a self-report scale used to screen for distress in patients with breast cancer. It consists of an 11-point visual analog scale from 0 (no distress) to 10 (extreme distress) and a problem list (PL). The PL includes 37 items divided into five dimensions: physical problems, emotional problems, family problems, practical problems, and spiritual/religious concerns. In this study, the Cronbach's α of the scale was 0.805, and the criterion-related validity (r) was 0.476 ($P < 0.001$), with satisfactory reliability and validity.

The Hospital Anxiety and Depression Scale (HADS). The HADS is used to screen patients for anxiety and depression.[19] Its subscales, each comprising seven items. The scale is scored on a four-point Likert scale (0–3). In China, a critical cutoff score of nine for anxiety or depression has shown good sensitivity and specificity.[20] Therefore, this study used a subscale score of nine and a total scale score of 18 as the cutoff scores.

Data analysis

SPSS 26.0 was used for statistical analysis. Descriptive analysis was used to calculate the median (quartile) and frequency of socio-demographic characteristics. Nonparametric tests and logistic regression were used to analyze the manifestations.

Validity

One clinical expert in oncology and breast surgery and two nursing experts were invited to conduct a review for content validity analysis (see Supplementary Table S3). The item- (I-CVI) and scale-level (S-CVI) content validity indices were determined. With the panel of experts numbering five or fewer, an I-CVI of 1 and an average S-CVI (S-CVI/Ave) of 0.90 or higher would indicate good scale content validity.[21]

To analyze criterion-related validity, the correlation coefficients between the DT-BC and HADS were calculated using the HADS as the criterion standard. Generally, a range of 0.4–0.8 is considered ideal.

Reliability

The reliability of the DT-BC was assessed using internal consistency, stability, and external consistency. Cronbach's alpha coefficient was used to evaluate the internal consistency of the questionnaire; values > 0.80 for the list of questions and > 0.70 for each dimension indicate good questionnaire reliability. Test-retest reliability was used to reflect the stability of the questionnaire, as represented by the Pearson correlation coefficient, the retest sample was at least 10% of the total sample size, and the retest period was 2–4 weeks for correlation analysis; a value $>$ 0.70 indicates good questionnaire stability. The Kappa statistic was used to test consistency between the two diagnostic methods; a value ≥ 0.75 indicates excellent consistency between the two methods, 0.40–0.75 indicates moderate to good consistency, and < 0.40 indicates poor consistency.[22] The kappa value was calculated using HADS as the standard.

DT-BC cutoff score

This study used ROC curves to calculate the sensitivity and specificity of the DT-BC and identify its optimal cutoff score compared to the HADS. The area under the curve (AUC) was used to determine the diagnostic accuracy of the DT-BC. AUC value > 0.9 means high accuracy, 0.7–0.9 means moderate accuracy and 0.5–0.7 means low accuracy.[23]

Manifestations of distress

To explore if there were differences in PL subscale scores between distressed and non-distressed patients across the diagnostic stages, single-factor and multifactor analyses were performed for each subscale of PL. Non-parametric tests were used for single factor analysis and binary logistic regression for multifactor analysis, which was statistically significant at $P < 0.05$. In order to improve the accuracy of the model and reduce the Type I error rate, the chi-square test was applied to exclude confounding factors such as age, occupation, and monthly family income. Before applying the Logistic model, the general information of the two groups (the distress group and the non-distress group) was analyzed, and the results showed no statistical difference. In the binary logistic regression model, sample weight correction was used to balance the effects between different groups of samples by assigning a weight to each sample. The logistic regression model goodness-of-fit test was evaluated by the Hosmer–Lemesho test (H-L test); $P > 0.05$ indicates a good model fit, and $P < 0.05$ indicates a poor model fit.

Results

Demographic data of patients with breast cancer

In this study, 710 questionnaires were distributed, and 699 valid questionnaires were recovered. Half of the patients were 49 years old, and most patients were Han ethnicity (99.43%), married (97.71%), and paid by public health service (93.84%). Demographic details of the participants are presented in Table 1. The number of participants at each stage and their DT-BC scores are detailed in Table 2.

Validity

The I-CVI of the 39 items was 1.00, and the S-CVI of the total question list was 1.00, indicating good content validity. Using HADS as the criterion, the results showed $r = 0.476$ ($P < 0.001$), indicating a moderate correlation between the DT and HADS.

Reliability

The Cronbach's α coefficient of the questionnaire was found to be 0.805 overall, with high internal consistency and good reliability. Calculation of coefficient alpha was not possible for the spiritual/religious dimension, as it consists of only one item. Cronbach's α coefficients for physical and emotional problems were acceptable (0.697 and 0.678, respectively), while family and practical problems were found to be unacceptable (0.385), and poor (0.520). In this study, 87 out of 699 patients with breast cancer completed the DT questionnaire again after 1–4 weeks. The test-retest reliability of the scale was 0.750 ($P < 0.001$). We mainly evaluated the consistency of the DT and the gold standard HADS screening for psychological distress. The Kappa value was 0.458 ($P < 0.01$), indicating moderate consistency between the DT and HADS.

DT-BC cutoff score

As shown in Fig. 1 and Table 3, using HADS ≥ 18 as the reference standard, the ROC of the DT-BC showed various optimal cutoff scores with moderate diagnostic accuracy, satisfactory sensitivity and specificity at different stages. At the diagnosis and postoperative treatment stages, the cutoff scores of both scales were 6, showing good accuracy (AUC = 0.862 and 0.877, 95% CI = 0.801–0.923 and 0.798–0.957, respectively; $P < 0.001$) with optimal sensitivity (0.714 and 0.750) and specificity (0.840 and 0.882). At the neoadjuvant and postoperative stages, their cutoff scores were 5, which showed good accuracy (AUC = 0.789 and 0.833, 95% CI = 0.679–0.898 and 0.750–0.916; $P < 0.001$), with optimum sensitivity (0.792 and 0.735) and specificity (0.750 and 0.831). At the rehabilitation stage, a cutoff score of four yielded an AUC of 0.767 (95% CI = 0.534–1.000; $P < 0.05$), with a sensitivity of 0.800 and specificity of 0.687.

Table 1
Demographic characteristics of the breast cancer patients ($N = 699$).

Characteristic		*n* (%)
Age (years, mean ± SD)[a]		48.19 ± 9.14
Race	Han	695 (99.43)
	Minorities	4 (0.57)
Employment[a]	Unemployed	273 (39.06)
	Employed	242 (34.62)
	Retired	60 (8.58)
	No answer	116 (16.60)
Education[a]	Primary school	93 (13.30)
	Junior high school	278 (39.77)
	High school	116 (16.60)
	College	203 (29.04)
Marital status	Single	3 (0.43)
	Married	683 (97.71)
	Divorced	5 (0.72)
	Widowed	8 (1.14)
Hospital charges paid by[a]	Public health service	656 (93.84)
	Medical insurance	2 (0.29)
	Self-paid	31 (4.43)
Hospital	Shijiazhuang	520 (74.39)
	Xingtai	179 (25.61)

[a] Missing value.

Table 2
Participant numbers and DT-BC scores by stage.

Stage	*n*	Mean ± SD
Diagnosis	186	3.91 ± 2.72
Neoadjuvant	108	3.77 ± 2.56
Postoperative	164	3.28 ± 2.38
Postoperative treatment	169	3.56 ± 2.61
Rehabilitation	72	2.74 ± 2.33

DT-BC, Breast Cancer Distress Thermometer; SD, standard deviation.

Prevalence and distribution of distress

The prevalence of distress varied at different treatment stages, with the highest prevalence at the neoadjuvant stage (37.0%), as shown in Fig. 2. Fig. 3 shows the varied distribution of distress among patients at each stage, with the PLs showing different trends throughout the disease. Physical and emotional problems remained high, whereas spiritual/religious issues were the least common.

Manifestations of distress

Diagnostic stage

Significant differences were observed in physical, emotional, family, and practical problems ($P < 0.001$, Supplementary Table S4). Emotional and practical problems were identified as manifestations of distress in patients during the diagnostic stage ($P < 0.05$, Supplementary Table S5, Fig. 4); the common problems were worry ($n = 29$), tension ($n = 29$), anxiety ($n = 26$), and family economic status ($n = 21$).

Neoadjuvant stage

Similar to the diagnostic stage, significant differences were observed in physical, emotional, family, and practical problems ($P < 0.01$, Supplementary Table S4) in the neoadjuvant stage. Physical and emotional problems were identified as the predominant manifestations of distress during this stage ($P < 0.01$, Supplementary Table S5, Fig. 4). The most common symptoms were fatigue ($n = 19$), pain ($n = 19$), nausea and vomiting ($n = 17$), anxiety ($n = 18$), and tension ($n = 16$).

Postoperative stage

The physical, emotional, family, and practical problems ($P < 0.001$, Supplementary Table S4) also differed significantly at the postoperative stage. Emotional and family problems were identified as the primary manifestations of distress ($P < 0.05$, Supplementary Table S5, Fig. 4). Common problems included worry ($n = 22$), tension ($n = 19$), anxiety ($n = 17$), and health problems of family members ($n = 19$).

Postoperative treatment stage

As seen in the earlier stages, the differences in physical, emotional, family, and practical problems ($P < 0.01$, Supplementary Table S4) were also significant during the postoperative treatment stage. Emotional and family problems were the primary manifestations ($P < 0.05$,

Table 3
Sensitivity and specificity of DT-BC at different stages against HADS.

Stage	Cut-off	Sensitivity	Specificity
Diagnosis	5	0.833	0.708
	6	0.714	0.840
	7	0.548	0.937
Neoadjuvant	4	0.792	0.619
	5	0.792	0.750
	6	0.583	0.845
Postoperative	4	0.853	0.669
	5	0.735	0.831
	6	0.471	0.923
Postoperative treatment	5	0.792	0.778
	6	0.750	0.882
	7	0.583	0.937
Rehabilitation	3	0.800	0.627
	4	0.800	0.687
	5	0.600	0.761

DT-BC, Breast Cancer Distress Thermometer; HADS, Hospital Anxiety and Depression Scale.

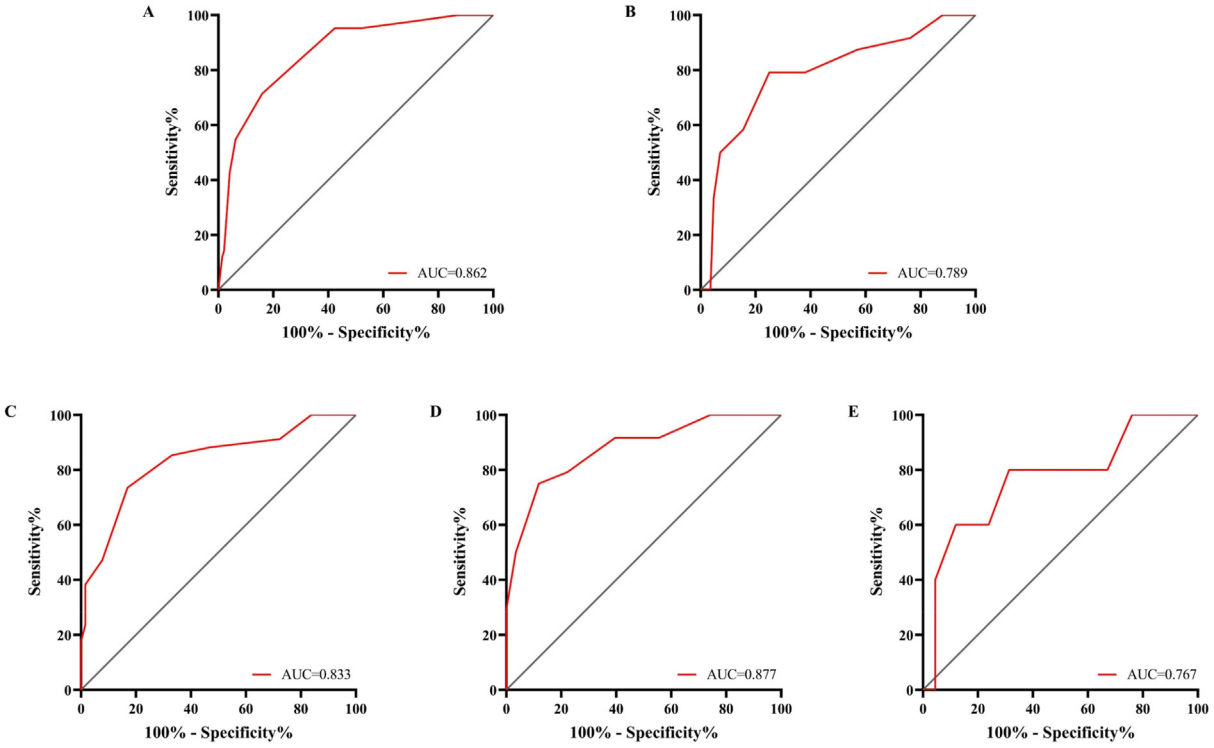

Fig. 1. ROC curves against HADS at different stages. A: Diagnosis stage; B: Neoadjuvant stage; C: Postoperative stage; D: Postoperative treatment stage; E: Rehabilitation stage. ROC, receiver operating characteristic; HADS, Hospital Anxiety and Depression Scale.

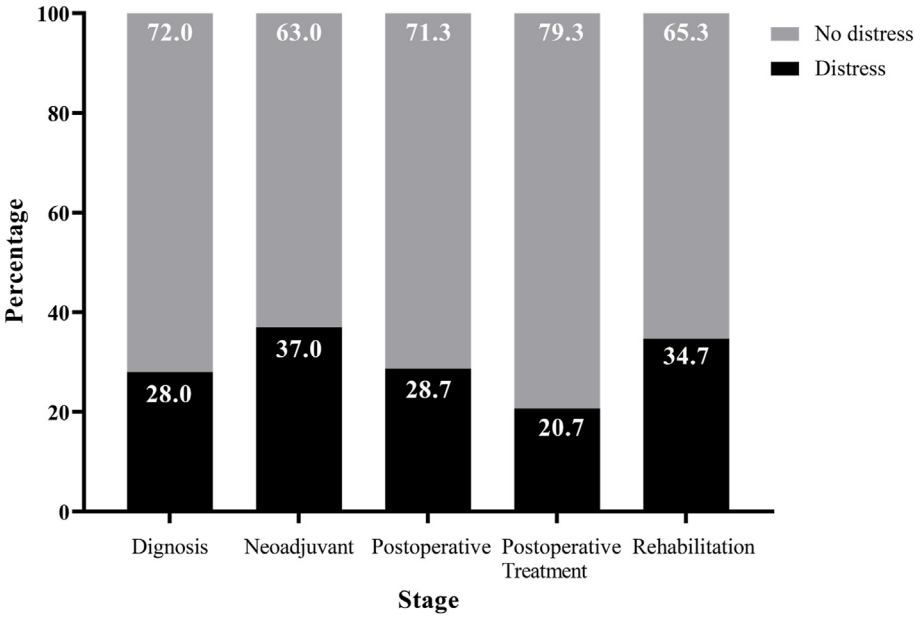

Fig. 2. Prevalence of distress in breast cancer patients at different stages.

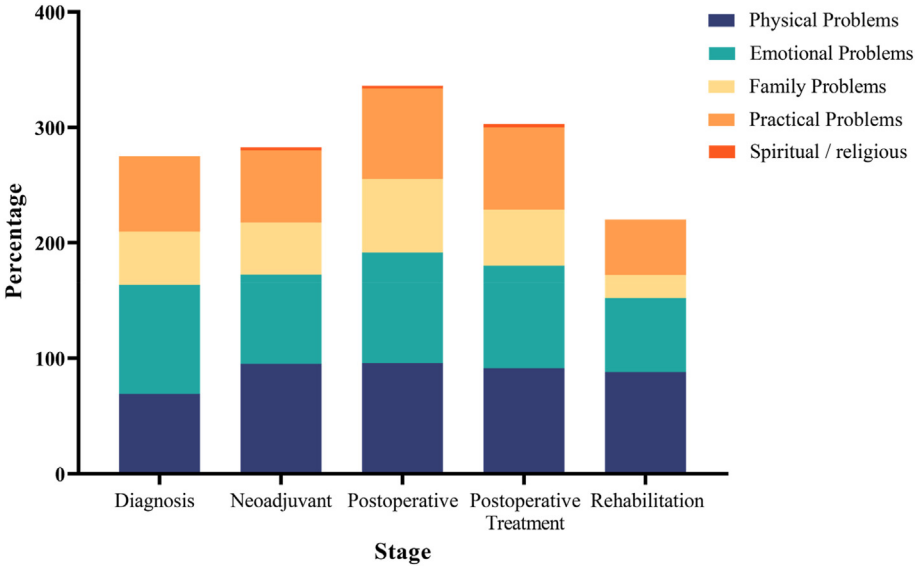

Fig. 3. The distribution of the PL in breast cancer patients with distress at different stages. PL, problem list.

Supplementary Table S5, Fig. 4). Worry ($n = 15$), irritability ($n = 12$), and being with children ($n = 12$) were common.

Rehabilitation stage

The results indicated statistically significant differences in physical, emotional, and practical problems ($P < 0.05$, Supplementary Table S4). Emotional problems were identified as manifestations of distress in patients during the rehabilitation stage ($P < 0.01$, Supplementary Table S5, Fig. 4), including irritability ($n = 9$), worry ($n = 7$), and nervousness ($n = 7$).

Discussion

In this study, we update and revise the DT to enhance its applicability for breast cancer patients, and to establish the cutoff scores of the DT-BC while identifying the prevalence and manifestations of distress across various disease stages.

The validity of the scale was tested using content- and criterion-related methods. The results indicated that the DT-BC effectively captures the psychology of patients with breast cancer. Moreover, it is significantly and positively correlated with HADS score. A study also found a moderate correlation between the two scales, confirming the efficacy of the DT-BC and demonstrating its good criterion-related validity.[24] Thus, the breast cancer version of the DT can be considered a valid screening tool for psychological distress.

The results of reliability tests indicated that the PL exhibits acceptable internal consistency for physical and emotional problems but poor to unacceptable internal consistency for practical and family problems, respectively. Similar to the results of this study, a study on the DT of stroke found that Cronbach's α of the total PL is higher than the values for the individual dimensions.[25] The number of items under family and practical problems was limited, and fewer patients reported these issues; consequently, the coefficient was slightly lower. Future studies should increase the sample size of patients at each stage to ensure the

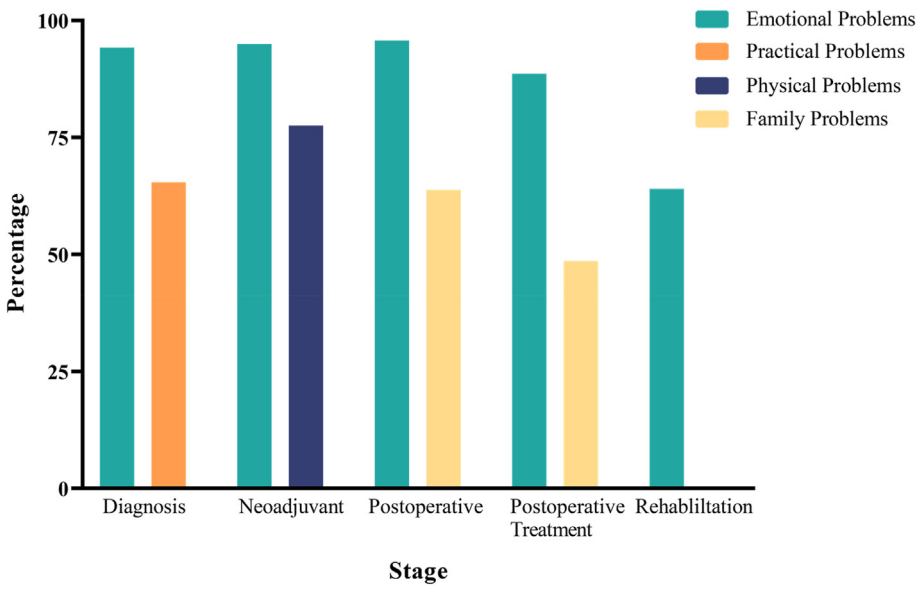

Fig. 4. Statistically significant manifestation of breast cancer patients with distress at different stages.

comprehensiveness of the data. The test-retest reliability of the scale was found to be 0.750, indicating excellent stability. When HADS was used as the standard for DT-BC, the Kappa value was 0.458 ($P < 0.01$), indicating a consistency between the two methods. Additionally, the diagnostic accuracy analysis of the DT-BC revealed an AUC ranging from 0.767 to 0.877 during the diagnosis and treatment stages, similar to other studies.[26,27] These results confirm the reliability and efficacy of the DT-BC as an effective screening tool for patients with breast cancer at different diagnosis and treatment stages in China.

The cutoff scores for the DT-BC were found to be different at different treatment stages for patients with breast cancer. Consistent with this, Y-J Chiou et al. proposed that the cutoff score of the DT varied according to patient characteristics.[28] Previous studies on DT-BC have shown similar findings. In Italy, the cutoff score for preoperative patients was five[26]; in Denmark, the cutoff score was seven.[27] Therefore, in different cultures, the same cutoff score cannot be used to screen for distress in different patients with cancer at different stages. Specific distinctions must be made.

The prevalence of distress in patients with breast cancer at the diagnostic stage was 28.0%, which was similar to the distress rate of 25.0% in the early diagnosis stage.[29] However, the results of this study differed from the standard 77.0% distress rate.[16] This can be attributed to differences in the cut-off score and participant characteristics. The manifestations of distress in patients with breast cancer at the diagnosis stage were emotional and practical problems, which is consistent with research on distress in newly diagnosed patients with breast cancer.[30] A breast cancer diagnosis can lead to many emotional problems, the most common of which are worry, tension, and anxiety. A lack of knowledge about breast cancer and concerns about screening results are the leading causes.[31] Providing patients with knowledge related to their illness and treatment, along with timely emotional support, can reduce psychological distress. Additionally, financial issues are prevalent among patients with cancer, particularly among rural women with breast cancer who lack a stable income. High treatment costs exacerbate economic strain.

Neoadjuvant chemotherapy can cause severe distress in patients with breast cancer.[32] However, few studies have investigated the psychological status of the patients during this stage. In this study, the prevalence of distress during the neoadjuvant stage was 37.0%, with physical and emotional problems being the main manifestations. In contrast, Lu et al. found a prevalence of 23.9% during this stage,[33] with the common problems being economic issues, tension, and worry. This difference could be attributed to the screening time, which was approximately 1–2 weeks for this study, after completing the treatment course. At this time, the patient's physical response was apparent. The screening time in the study by Lu et al. began with treatment initiation. At this stage, the side effects of the chemotherapy drugs were not obvious. Chemotherapy drugs can cause severe adverse reactions in the body and affect patients' emotions, resulting in anxiety and tension.[34] Therefore, informing patients about the adverse effects of chemotherapy and providing targeted coping strategies can help alleviate their suffering.

The prevalence of distress in patients with breast cancer at the postoperative stage was 28.7%. Conversely, a longitudinal study reported a prevalence of 16.7%,[29] whereas Yang et al. found a prevalence of 74.1%.[35] This may have been because of the different criteria for judging patient distress. In this study, a DT score ≥ 5 was considered as distress, while in the study by Yang et al., it was 4. Furthermore, Andreu et al. used the Brief Symptom Inventory 18 (BSI-18) as a screening tool for distress.[29]

In this study, the primary manifestations of distress in postoperative patients were emotional and family problems. Early postoperative patients may have symptoms such as wound effusion and limited arm movement, often causing concerns about their recovery. In addition, trauma caused by surgery causes a significant change in the family roles, from caregivers to patients. They worry about the negative effects of the disease, such as mental burden or distress, on their families.[36] Therefore, at this stage, patient recovery and stress reduction can be assured by taking precautions before, during, and after treatment, providing timely guidance for rehabilitation, and encouraging the presence of family members.

Our results showed that the prevalence of distress in patients with breast cancer was lowest (20.7%) at the postoperative treatment stage. After diagnosis and early treatment, patients with breast cancer gradually come to accept their condition and confront the associated challenges.[37] Moreover, this is the final stage of treatment, following which the patients may return to everyday life.[36] We found that the predominant manifestations of distress during this stage included emotional and family problems, with worry being the most common emotional problem, consistent with the findings of Zhao et al.[17] One study also found that worry persisted from the first to the 14th day after surgery.[38] Furthermore, patients experience role disorders during treatment, and managing children is a common problem, especially for young patients.[39] Emotional and social support are the primary methods used to reduce distress at this stage.

This study found that the prevalence of distress in patients with breast cancer at the rehabilitation stage was 34.7% in China, which was higher than that in foreign patients of breast cancer.[40] Due to cultural differences, women in China play a pluralistic role in society, which includes

educating children, caring for the elderly, and considering career development. The dual pressures of work and family have led to a high distress rate in patients with breast cancer returning to society. The manifestations of distress in such patients solely include emotional problems such as irritability, worry, and tension. Many patients reported that despite treatment completion, they feel uncured and find it challenging to return to everyday life.[41] Furthermore, the use of endocrine drugs affects the patient's hormone levels, causing menopausal symptoms and psychological changes that manifest as irritability.

Implications for nursing practice and research

This study provides a specific screening tool for assessing psychological distress in patients with breast cancer. The cutoff score of the DT-BC during each stage of breast cancer was determined, enabling medical professionals to accurately identify distress in patients at each treatment stage, improve screening accuracy, and conserve medical resources. Additionally, this study reveals that the manifestations of distress vary at different stages of breast cancer, aiding in the provision of personalized interventions for patients.

Limitations

This study has the following limitations. First, our study was conducted with Chinese breast cancer patients, and the results are primarily applicable to this specific demographic. While our findings provide valuable insights for Chinese patients, further research is needed to confirm whether these results can be extended to other countries and ethnicities. Second, only the HADS was used as the reference standard. Using multiple reference scales to plot the ROC curves may increase the representativeness of the results. Third, this study involves multiple objectives, including updating the DT scale, determining cutoff scores, and investigating the prevalence of distress in breast cancer patients. Although these objectives are closely related logically, incorporating them into a single study may lead to an overly complex research design. Moreover, we attempted to investigate the prevalence of distress using the updated DT scale in this study. However, this approach may affect the generalizability of the results before external validation.

Conclusions

This study updated and revised the Chinese version of the DT to create a psychological distress assessment tool more suitable for patients with breast cancer. The cutoff score of the DT-BC for each diagnosis and treatment stage was determined. Finally, we found that the prevalence and manifestations of distress in patients with breast cancer varied across the different stages.

CRediT authorship contribution statement

Weijing Qi: Conceptualization, Project administration, Supervision, Writing – review &editing. **Qi Liu:** Investigation, Visualization, Formal analysis, Writing - Original Draft, Writing - Review & Editing. **Ziqi Wei:** Visualization, Writing – original draft, Writing – review & editing. **Ping Li:** Investigation, Formal analysis, Visualization. **Meng Wang:** Investigation, Project administration. **Weina Wang:** Investigation, Project administration. **Yixin Qi:** Resources, Project administration. **Jie Hu:** Funding acquisition, Supervision. All authors have read and approved the final manuscript.

Ethics statement

The study was approved by the Ethics Committee of the Fourth Hospital of Hebei Medical University (Approval No. 20210621) and the Xingtai People's Hospital (Approval No. 2021038) and was conducted in accordance with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. All participants provided written informed consent.

Data availability statement

The data supporting this study's findings are available from the corresponding author, JH, upon reasonable request.

Declaration of generative AI and AI-assisted technologies in the writing process

No AI tools/services were used during the preparation of this work.

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Declaration of competing interest

The authors declare no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.apjon.2025.100705.

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