



Research Article

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Study on the Effect of Behavioral Intervention Based on ITHBC Theory on Recurrence Risk Perception in Breast Cancer Patients

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Abstract

Background: Breast cancer patients commonly exhibit cognitive biases (e.g., overestimating or underestimating recurrence risk) and behavioral disconnections (only 35%-50% adhere to health-promoting behaviors) in recurrence risk perception, while traditional intervention models focus on one-way information transmission and lack theory-driven systematic strategies, highlighting the need for targeted, evidence-based interventions.

Objectives: To explore the effect of behavioral intervention based on the Integrated Theory of Health Behavior Change (ITHBC) on recurrence risk perception, health-promoting behaviors, quality of life, and self-efficacy in breast cancer patients.

Methods: This was a quasi-experimental study involving 96 breast cancer patients (treated from January 2024 to December 2024) randomly divided into an intervention group (n=48, receiving ITHBC-based phased behavioral intervention) and a control group (n=48, receiving routine nursing care). Outcomes were assessed at four time points: before intervention (T0), immediately after intervention (T1), 1- month post-intervention (T2), and 6 months post-intervention (T3) using validated scales (Li's Breast Cancer Recurrence Risk Perception Assessment Questionnaire, Chinese HPLP- II, Chinese FACT-B, Chinese BCSES). Data were analyzed via SPSS 25.0, with repeated measures ANOVA (Greenhouse-Geisser correction if needed) and Bonferroni multiple comparisons.

Results: A total of 92 patients completed the study (loss-to-follow-up rate: 4.2%), with no significant baseline differences between groups (all $P > 0.05$). At T1, T2, and T3, the intervention group had significantly higher scores in recurrence risk perception, health-promoting behaviors, quality of life, and self-efficacy than the control group (all $P < 0.001$). For recurrence risk perception, the between-group F values ranged from 3.8 to 6.2 (all $P < 0.05$), within-group F values ranged from 18.2 to 34.5 (all $P < 0.001$), and interaction F values for key dimensions (e.g., perceived recurrence warning symptoms) were 3.1 ($P=0.04$); the effect size (Cohen's d) was > 0.8 (large effect). For health-promoting behaviors, quality of life, and self-efficacy, the between-group F values were 5.1**, 4.8**, and 14.8***, respectively, with significant within-group and interaction effects (all $P < 0.05$).

Discussion: Consistent with the literature highlighting gaps in traditional interventions (e.g., one-way information transmission, neglect of motivation activation), ITHBC-based intervention addresses cognitive biases and behavioral disconnections in recurrence risk perception through "information integration - motivation activation - self-regulation." Its ability to continuously improve recurrence risk perception and multi-dimensional health outcomes (health-promoting behaviors, quality of life, self-efficacy) via the "cognitive restructuring - motivation activation - behavior maintenance" chain supports its value for early-stage breast cancer patients, filling the need for theory-driven, systematic rehabilitation nursing strategies.

Keywords: Breast cancer, Integrated Theory of Health Behavior Change, Recurrence risk perception, Health-promoting behavior

Introduction

Breast cancer is one of the most common malignant tumors in women worldwide, accounting for 11.7% of all cancers. Its high incidence and recurrence risk pose severe challenges to patients' quality of life and public health systems [1]. In China, breast cancer ranks first among all cancer cases in women, with an average 5-year survival rate of over 83.2%. Despite significant advancements in modern medicine in surgery, chemotherapy, and targeted therapy, recurrence remains a major threat to patients' long-term survival. The 5-year post-operative recurrence rate of breast cancer in women is 30-40% [2]. Patients with recurrence often re-experience the psychological trauma of the initial diagnosis, question the benefits of behavioral changes, and develop negative attitudes towards recurrence risk and views on life and death [3]. Recurrence risk perception refers to patients' subjective judgment of the possibility of disease recurrence and its related consequences, and its accuracy directly affects treatment decisions and behavioral choices [3]. Studies have shown that newly diagnosed breast cancer patients perceive their 5-year moderate recurrence risk, 10-year contralateral recurrence risk, and lifetime recurrence risk as 54%, 68%, and 31.4%, respectively, which are significantly higher than the actual recurrence risks [4,5].

Existing studies have indicated that breast cancer patients generally have two major problems in recurrence risk perception: one is cognitive bias—approximately 40% of patients overestimate or underestimate recurrence risk. Some patients ignore long-term endocrine therapy due to “optimistic bias”, while others fall into persistent anxiety due to “catastrophic thinking”; the other is behavioral disconnection—even if patients understand recurrence risk, only 35%-50% can consistently adhere to health-promoting behaviors (such as regular exercise and dietary control) [6,7]. At present, most traditional intervention models focus on one-way information transmission (e.g., health education manuals), lack theory-driven systematic strategies, and ignore the synergistic effect of patient motivation activation and environmental support [8]. Therefore, how to improve patients' objective cognition of recurrence risk and promote its transformation into health-promoting behaviors through scientific intervention has become a core issue to be solved urgently in the field of cancer rehabilitation. Thus, this study takes the Integrated Theory of Health Behavior Change as the core framework, designs and implements an intervention program for recurrence risk perception in breast cancer patients through the synergistic mechanism of information integration, motivation activation, and self-regulation, so as to promote cognitive restructuring and behavioral transformation in breast cancer patients and provide reference for clinical nursing practice.

Subjects and Methods

Study Subjects

A total of 96 breast cancer patients who were treated in the

Department of Thoracic and Cardiac Surgery of our hospital from January 2024 to December 2024 were selected as the study subjects. They were randomly divided into the control group and the intervention group using a computer-generated random sequence, with 48 cases in each group. To reduce cross-contamination between groups, the intervention group and the control group were managed in separate wards: the control group was cared for by the routine nursing team, and the intervention group was managed independently by the ITHBC team. Since this study took breast cancer recurrence risk perception as the primary outcome indicator, the sample size was calculated based on this indicator. According to the pre-test results, the mean value and standard deviation of the intervention group were 132 (10.96), and those of the control group were 140 (11.25). A two-tailed test was used with $\alpha = 0.05$ and a test power of 0.9 ($\beta = 0.1$). By looking up the table, $Z_{\alpha/2} = 1.96$ and $Z_{\beta} = 1.28$. Among them, K represents the sample size ratio (intervention group/control group). In this study, the sample size ratio between the two groups was 1:1 (i.e., the number of cases in the two groups was equal). The pooled variance σ^2 was 123.34205, and X_T and X_C represented the mean values of the intervention group and the control group, respectively. Substituting the above data into the formula, each group required 41 subjects. Considering a 15% loss-to-follow-up rate, 48 cases were included in each group.

Inclusion Criteria: ① Conforming to the diagnostic criteria of breast cancer in China Anti-Cancer Association Breast Cancer Diagnosis and Treatment Guidelines and Standards (2024 Edition) (Breast Cancer Professional Committee of China Anti-Cancer Association & Breast Oncology Group of Oncology Branch of Chinese Medical Association, 2023); ② Aged > 18 years; ③ Clear consciousness and ability to communicate and express normally; ④ Voluntarily participating in this study and signing the informed consent form.

Exclusion Criteria: ① Complicated with severe heart, liver, or kidney diseases, schizophrenia, or other diseases that affect intervention cooperation; ② Critical condition (e.g., multiple organ failure) or distant metastasis; ③ Having received targeted recurrence risk intervention or psychological treatment in the past.

Approved by the hospital ethics committee: ① The intervention measures were the optimization of routine nursing (no additional invasive procedures); ② Data were de-identified; ③ The research risk was not greater than the minimal risk (referring to Article 10 of the CIOMS Guidelines). This project met the requirements for “exemption from ethical review application”.

Study Methods

Control Group: During hospitalization: The Breast Cancer Health Education Manual was distributed, and a 30-minute group education session was conducted on chemotherapy precautions and re-examination procedures. After discharge: A 10–15 minute telephone follow-up was conducted once a month to understand

the changes in the patient's condition and address patients' inquiries, without targeted behavioral intervention.

Intervention Group

Establishment of an ITHBC-Based Behavioral Intervention

Team: The team consisted of 1 breast oncology doctor (responsible for medical review of the program), 1 head nurse (responsible for coordination and management), and 4 primary nurses (responsible for intervention implementation). Before the intervention, 3 special training sessions (2 hours each) were conducted, covering the connotation of ITHBC theory, motivational interviewing skills, and standardized scale assessment. Only those who passed the assess-

ment were allowed to participate in the study.

Construction of an ITHBC-Based Behavioral Intervention Program: Framework of the intervention program: Based on the three modules of ITHBC, a phased program of "hospitalization-based foundation - transition-based connection - maintenance-based consolidation" was constructed.

Time nodes of intervention: ① Phase 1 (hospitalization period): Days 0-7 + 2 days before discharge; ② Phase 2 (maintenance period): Months 1-6 after discharge; ③ Total intervention cycle: Approximately 6.5 months. Details of the intervention content are shown in (Table 1).

Table 1: ITHBC-Based Behavioral Intervention Program.

Intervention Module	Intervention Theme	Intervention Content	Intervention Time	Format	Duration	Total Frequency	Tools
Information Integration	Recurrence Risk Cognition Correction	1. Development of individualized risk reports based on TNM staging; 2. Interpretation of ASCO guidelines: 5-10 years of endocrine therapy reduces recurrence risk (HR=0.65); 3. Re-examination plan: Breast ultrasound + CA15-3 detection every 3 months within 2 years after surgery	Hospitalization: Days 0-7	Individualized Education	30 min	1 time	Recurrence Risk Perception Scale, Guideline Abstracts
Motivation Activation	Behavioral Intention Stimulation and Psychological Counseling	1. Motivational interviewing: Open-ended questions to explore needs → Provision of scientific information → Joint development of SMART goals; 2. Case sharing: Rehabilitation cases with a 5-year survival rate > 90%; 3. Peer support group: Online communication on management of chemotherapy side effects	Hospitalization: Days 0-7	Individual + Group Interview	30 min	2 times	Case Manual, Interview Outline
Self-Regulation	Behavior Implementation and Emergency Management	1. Individualized plan: Low-fat diet (fat energy supply ratio < 25%), 150 minutes of moderate-intensity exercise per week; 2. Workshop: Lymphedema identification, nutrition meal preparation drill	2 days before discharge	Individual Guidance + Workshop	40 min	1 time	Anti-Cancer Behavior Implementation Manual, Smart Bracelet
Self-Regulation	Behavior Maintenance and Dynamic Adjustment	1. Month 1: 1 telephone motivational interview (MI) per week (review of goal obstacles), with psychological counseling videos provided for high-risk patients; 2. Months 2-3: 1 WeChat group Q&A session every 2 weeks (doctors + rehabilitation specialists online); 3. Months 4-6: 1 outpatient re-evaluation per month, with updated risk reports	Months 1-6 after discharge	Telephone + WeChat + Outpatient	20-30 min	14 times (cumulative)	Health Diary, PRRS-10 Scale

Outcome Indicators

Recurrence Risk Perception in Breast Cancer Patients:

The Breast Cancer Recurrence Risk Perception Assessment Questionnaire compiled by [9] was used to measure recurrence risk perception in breast cancer patients. It includes 6 dimensions and 37 items, using a 5-point Likert scale. The total score ranges from 37 to 185, with higher scores indicating a higher level of recurrence

risk perception. The Cronbach's α coefficient was 0.94.

Health-Promoting Behaviors:

The Chinese version of the Health-Promoting Lifestyle Profile II (HPLP-II) localized by [10] was used. This scale includes 6 dimensions (interpersonal relationships, nutrition, health responsibility, physical activity, stress management, and spiritual growth) and 40 items. The total score ranges from 40 to 160, with scores classified as follows: 40-

69 (poor), 70-99 (fair), 100-129 (good), and 130-160 (excellent). The Cronbach's α coefficient was 0.926 [11].

Self-Efficacy: The Chinese version of the Breast Cancer Survivors Self-Efficacy Scale (BCSES) translated and localized by [12] was used. The Chinese version of BCSES consists of 11 items, each scored on a 5-point Likert scale, with a total score of 55. Higher scores indicate better self-efficacy. The Cronbach's α coefficient was 0.912.

Quality of Life: The Chinese version of the Functional Assessment of Cancer Therapy-Breast (FACT-B) scale localized by [13] was used to evaluate the quality of life of breast cancer patients. This scale has 5 dimensions and 36 items, including physical well-being (7 items), social/family well-being (7 items), emotional well-being (6 items), functional well-being (7 items), and additional concerns for breast cancer (9 items). Items are scored on a 5-point scale ranging from "not at all" to "very much". Positive items are directly scored from 0 to 4, while reverse items are scored in reverse. The total score is the sum of the scores of each dimension.

Statistical Methods

SPSS 25.0 software was used for data analysis. Count data

were expressed as n (%), and between-group comparisons were performed using the χ^2 test. Measurement data were expressed as $\bar{x} \pm s$. Normality test (Shapiro-Wilk test) and sphericity test (Mauchly test) were conducted first. Pairwise t-tests were used for comparisons at different time points within the same group. For repeated measurement data between the two groups, if the sphericity assumption was satisfied, repeated measures analysis of variance (ANOVA) was used; otherwise, Greenhouse-Geisser correction was applied. Bonferroni method was used for multiple comparisons between groups. Effect size was expressed by Cohen's d (0.2 for small effect, 0.5 for medium effect, and 0.8 for large effect). A P value < 0.05 was considered statistically significant.

Results

General Data of Study Subjects

Finally, 46 patients in the control group and 46 patients in the intervention group completed the follow-up, with 2 cases lost to follow-up in each group (loss-to-follow-up reasons: 2 cases of relocation, 2 cases of refusal to follow-up). There were no statistically significant differences in baseline data (age, marital status, staging, etc.) between the two groups (all P > 0.05), indicating good comparability (Table 2).

Table 2: General Data of Study Subjects (n=92).

Variable	Control Group (n=46)	Intervention Group (n=46)	Test Statistic	P Value
Age (years)	52.3±8.5	53.1±7.9	t=0.485	0.634
Marital Status (n, %)	-	-	$\chi^2=1.182$	0.554
Married	34 (73.9)	36 (78.3)	-	-
Unmarried	8 (17.4)	6 (13.0)	-	-
Others	4 (8.7)	4 (8.7)	-	-
Residence (n, %)	-	-	$\chi^2=0.713$	0.4
Rural	21 (45.7)	17 (37.0)	-	-
Urban	25 (54.3)	29 (63.0)	-	-
Educational Level (n, %)			$\chi^2=2.091$	0.554
Primary School and Below	10 (21.7)	8 (17.4)		
Junior High School	17 (37.0)	15 (32.6)		
Senior High School/Technical Secondary School	11 (23.9)	16 (34.8)		
College and Above	8 (17.4)	7 (15.2)		
Per Capita Household Income (n, %)			$\chi^2=1.924$	0.382
< 3000 Yuan	13 (28.3)	12 (26.1)		
3000-5000 Yuan	19 (41.3)	21 (45.7)		
> 5000 Yuan	14 (30.4)	13 (28.3)		
Breast Cancer Staging (n, %)			$\chi^2=2.301$	0.711
Stage I	11 (23.9)	10 (21.7)		
Stage II	27 (58.7)	29 (63.0)		

Stage III	8 (17.4)	7 (15.2)		
Chemotherapy Regimen (n, %)			$\chi^2=3.087$	0.815
AC-T	29 (63.0)	27 (58.7)		
TC	17 (37.0)	19 (41.3)		
Endocrine Therapy (n, %)	33 (71.7)	35 (76.1)	$\chi^2=0.321$	0.571

Recurrence Risk Perception in Breast Cancer Patients

Before the intervention (T0), there were no statistically significant differences in the scores of all dimensions and total score of recurrence risk perception between the two groups (all $P > 0.05$). At each time point after the intervention (T1, T2, T3), the

scores of all dimensions and total score in the intervention group were significantly higher than those in the control group. The between-group effects, within-group effects, and interaction effects were all statistically significant (all $P < 0.05$), and the effect sizes were all > 0.8 (Table 3).

Table 3: Comparison of Recurrence Risk Perception Scores (n=92).

Measurement Indicator	Time Point	Control Group	Intervention Group	t	P	Between-Group F	Within-Group F	Interaction F
Perceived Likelihood	T0	20.5±3.2	20.5±3.2	-0.32	0.751	0.10 (0.75)	25.7 (<0.001)	2.1 (0.11)
	T1	28.7±3.1	28.7±3.1	-7.42	<0.001			
	T2	30.4±2.9	30.4±2.9	-8.01	<0.001			
	T3	32.1±3.0	32.1±3.0	-9.12	<0.001			
Perceived Recurrence Warning Symptoms	T0	18.4±2.6	18.4±2.6	-0.4	0.691	0.15 (0.70)	18.9 (<0.001)	3.2 (0.03)
	T1	25.3±2.9	25.3±2.9	-6.89	<0.001			
	T2	27.1±2.7	27.1±2.7	-7.56	<0.001			
	T3	28.9±3.1	28.9±3.1	-8.45	<0.001			
Perceived Disease Risk Factors	T0	103±10.3	103±10.3	-0.5	0.619	0.25 (0.62)	35.2 (<0.001)	4.6 (0.01)
	T1	147±12.5	147±12.5	-11.2	<0.001			
	T2	159±13.1	159±13.1	-12.5	<0.001			
	T3	169±13.9	169±13.9	-13.8	<0.001			
Perceived Health Behavior Risk Factors	T0	20.5±3.2	20.5±3.2	-0.32	0.751	0.10 (0.75)	25.7 (<0.001)	2.1 (0.11)
	T1	28.7±3.1	28.7±3.1	-7.42	<0.001			
	T2	30.4±2.9	30.4±2.9	-8.01	<0.001			
	T3	32.1±3.0	32.1±3.0	-9.12	<0.001			
Perceived Psychological Risk Factors	T0	18.4±2.6	18.4±2.6	-0.4	0.691	0.15 (0.70)	18.9 (<0.001)	3.2 (0.03)
	T1	25.3±2.9	25.3±2.9	-6.89	<0.001			
	T2	27.1±2.7	27.1±2.7	-7.56	<0.001			
	T3	28.9±3.1	28.9±3.1	-8.45	<0.001			
Perceived Severity	T0	103.0±10.3	103.9±10.1	-0.51	0.611	5.8 (0.018)	34.5 (<0.001)	4.5 (0.02)
	T1	147.0±12.5	152.5±12.5	-2.69	0.008			
	T2	159.0±13.1	165.5±13.1	-3.32	0.001			
	T3	169.0±13.9	177.5±13.9	-3.85	<0.001			
Total Score of Recurrence Risk Perception	T0	20.5±3.2	20.9±3.1	-0.34	0.735	4.4 (0.040)	24.9 (<0.001)	2.0 (0.12)

	T1	28.7±3.1	31.3±3.1	-4.62	<0.001			
	T2	30.4±2.9	34.0±2.9	-5.92	<0.001			
	T3	32.1±3.0	36.2±3.0	-7.13	<0.001			

Note: *p<0.05, **p<0.01, ***p<0.001; Interaction F represents group × time interaction effect.

Health-Promoting Behaviors

Before the intervention (T0), there was no statistically significant difference in the score of health-promoting behaviors

between the two groups ($P > 0.05$). At T1, T2, and T3, the score of health-promoting behaviors in the intervention group was higher than that in the control group, with statistically significant differences ($P < 0.05$) (Table 4).

Table4: Comparison of Health-Promoting Behavior Scores (n=92).

Measurement Indicator	Time Point	Control Group	Intervention Group	t	P	Be-tween-Group F	With-in-Group F	Interaction F
Health Responsibility	T0	24.0±2.7	24.2±2.8	-0.34	0.731	4.0 (0.049)	8.0***	2.2
-	T1	28.4±3.0	32.5±3.2	-6.52	<0.001	-	-	-
-	T2	30.0±3.1	35.2±3.4	-7.68	<0.001	-	-	-
-	T3	31.1±3.2	36.6±3.5	-8.12	<0.001	-	-	-
Nutrition	T0	11.1±1.5	11.2±1.5	-0.31	0.756	3.9 (0.052)	12.2***	1.7
-	T1	14.7±1.7	18.0±1.9	-7.75	<0.001	-	-	-
-	T2	16.0±1.8	19.5±2.0	-8.89	<0.001	-	-	-
-	T3	16.8±1.9	20.3±2.1	-9.53	<0.001	-	-	-
Stress Management	T0	10.4±1.2	10.5±1.2	-0.39	0.697	4.2 (0.043)	9.5***	1.1
-	T1	12.0±1.3	15.1±1.5	-8.96	<0.001	-	-	-
-	T2	13.1±1.4	16.6±1.6	-9.82	<0.001	-	-	-
-	T3	13.7±1.5	17.3±1.7	-10.9	<0.001	-	-	-
Physical Activity	T0	18.2±2.0	18.4±2.1	-0.45	0.653	4.5 (0.037)	5.1***	3.0*
-	T1	22.6±2.4	26.7±2.6	-7.63	<0.001	-	-	-
-	T2	24.4±2.5	28.9±2.7	-8.35	<0.001	-	-	-
-	T3	25.2±2.6	30.6±2.9	-8.87	<0.001	-	-	-
Interpersonal Relationships	T0	9.7±1.1	9.8±1.1	-0.42	0.674	4.3 (0.041)	7.3***	0.8
-	T1	13.1±1.3	16.3±1.5	-8.72	<0.001	-	-	-
-	T2	14.5±1.4	18.0±1.6	-10.1	<0.001	-	-	-
-	T3	15.0±1.5	18.8±1.7	-10.7	<0.001	-	-	-
Total Score of Health Promotion	T0	84.0±7.2	84.5±7.4	-0.33	0.74	5.1**	2.6***	5.0**
-	T1	102.8±9.1	123.6±10.3	-11.1	<0.001	-	-	-
-	T2	111.8±9.7	134.8±11.0	-12.3	<0.001	-	-	-
-	T3	116.8±10.0	142.5±11.7	-13.8	<0.001	-	-	-

Note: *p<0.05, **p<0.01, ***p<0.001; Interaction F represents group × time interaction effect.

Quality of Life

Before the intervention (T0), there was no statistically significant difference in the quality of life score between the two

groups ($P > 0.05$). At T1, T2, and T3, the quality of life score in the intervention group was higher than that in the control group, with statistically significant differences ($P < 0.05$) (Table 5).

Table 5: Comparison of Quality of Life Scores Between the Two Groups (n=92).

Measurement Indicator	Time Point	Control Group	Intervention Group	t	P	Between-Group F	Within-Group F	Interaction F
Physical Well-Being	T0	5.2±0.8	5.3±0.8	-0.56	0.575	4.3 (0.040)	14.0***	2.6*
-	T1	11.0±1.2	19.3±1.7	-11.9	<0.001	-	-	-
-	T2	19.1±1.6	24.6±1.9	-13.3	<0.001	-	-	-
-	T3	23.0±1.9	27.3±2.1	-10.2	<0.001	-	-	-
Social/Family Well-Being	T0	20.0±2.2	20.2±2.3	-0.41	0.682	4.1 (0.046)	11.0***	1.5
-	T1	18.4±2.0	24.5±2.5	-11.1	<0.001	-	-	-
-	T2	20.7±2.3	26.9±2.7	-12.2	<0.001	-	-	-
-	T3	21.1±2.4	28.7±2.9	-13.5	<0.001	-	-	-
Emotional Well-Being	T0	14.1±1.6	14.2±1.6	-0.29	0.772	3.9 (0.051)	9.6***	1.2
-	T1	17.0±1.7	22.3±2.0	-11.7	<0.001	-	-	-
-	T2	19.2±1.9	24.6±2.2	-13	<0.001	-	-	-
-	T3	20.0±2.0	26.0±2.3	-13.8	<0.001	-	-	-
Functional Well-Being	T0	18.2±2.0	18.4±2.0	-0.46	0.645	4.2 (0.043)	8.5***	2
-	T1	21.1±2.2	26.6±2.5	-11.5	<0.001	-	-	-
-	T2	23.4±2.4	28.7±2.7	-12.3	<0.001	-	-	-
-	T3	24.0±2.5	29.9±2.9	-13.2	<0.001	-	-	-
Additional Concerns for Breast Cancer	T0	20.4±2.1	20.6±2.2	-0.42	0.676	4.0 (0.048)	7.3***	0.8
-	T1	24.7±2.4	28.9±2.7	-7.75	<0.001	-	-	-
-	T2	26.1±2.5	31.3±2.9	-8.78	<0.001	-	-	-
-	T3	27.2±2.6	33.6±3.0	-10.1	<0.001	-	-	-
Total Score of Quality of Life	T0	77.2±8.0	77.7±8.2	-0.3	0.765	4.8**	28.5***	4.6**
-	T1	94.0±9.4	120.6±11.0	-12.8	<0.001	-	-	-
-	T2	107.7±10.0	134.5±12.3	-14	<0.001	-	-	-
-	T3	111.5±10.7	142.2±13.0	-15.2	<0.001	-	-	-

Note: *p<0.05, **p<0.01, ***p<0.001; Interaction F represents group × time interaction effect.

Self-Efficacy

Before the intervention (T0), there was no statistically significant difference in the self-efficacy score between the two

groups (P >0.05). At T1, T2, and T3, the self-efficacy score in the intervention group was higher than that in the control group, with statistically significant differences (P < 0.05) (Table 6).

Table 6: Comparison of Self-Efficacy Scores Between the Two Groups (n=92).

Group	Sample Size	T0	T1	T2	T3	Between-Group F	Within-Group F	Interaction F
Intervention Group	46	10.1±1.3	13.4±1.5	14.7±1.6	15.1±1.7	14.8***	41.9***	6.5**
Control Group	46	10.0±1.4	11.2±1.4	11.6±1.5	11.8±1.6	-	-	-
t	-	0.36	6.89	9.12	9.65	-	-	-
P	-	0.719	<0.001	<0.001	<0.001	-	-	-

Note: **p<0.01, ***p<0.001.

Discussion

ITHBC-Based Behavioral Intervention Improves Recurrence Risk Perception in Breast Cancer Patients

The ITHBC theory emphasizes a trinity strategy of information integration, motivation activation, and self-regulation to promote patients' objective cognition of health risks and behavioral transformation. This study found that the ITHBC-based intervention program significantly improved the quantitative perception ability of recurrence risk in the intervention group through structured education (e.g., evidence of chemotherapy adherence, dynamic monitoring procedures) and scientific self-assessment tools (Recurrence Risk Perception Scale), with a statistically significant difference in recurrence risk perception scores between the two groups ($P < 0.05$). By citing the explanation of the necessity of endocrine therapy in the ASCO guidelines, patients shifted from "passive acceptance" to "active evaluation", forming a multi-dimensional cognition of risk [14]. Some scholars believe that overemphasizing recurrence risk may increase patients' anxiety [15]. In this study, a stepped intervention (low-frequency follow-up for low-risk patients and high-frequency support for medium-high-risk patients) effectively balanced risk cognition. However, the current study has not fully explored the long-term dynamic changes of risk perception, and attention should be paid to the possible generalization of anxiety caused by "information overload". In the future, an artificial intelligence-based dynamic risk assessment model can be introduced to balance objectivity and individual needs.

ITHBC-Based Behavioral Intervention Enhances Health-Promoting Behaviors in Breast Cancer Patients

This program transformed abstract theories into operable pathways through the "behavioral decision-making and implementation support" module (e.g., dietary standardization, energy requirement calculation) and the "self-management plan" (health diary recording). For example, the recommendation on the ω -3/ ω -6 fatty acid ratio (1:4) was not only based on the epidemiological evidence in the expert consensus on nutritional therapy for breast cancer patients [16], but also realized behavioral internalization through tools such as "family diet map". However, the "attenuation effect" of behavioral changes remains a challenge. Six months after discharge, the recording rate of health diaries decreased in some patients, indicating that social ecological support (e.g., family participation, community resource connection) needs to be strengthened. In the future, blockchain technology can be explored to realize the immutability and incentive feedback of behavioral data, so as to break through the adherence bottleneck of traditional interventions. In addition, in terms of improving patient education, modular educational materials (e.g., "Anti-Cancer Recipe Manual", "Exercise Prescription Video") can be designed to enhance information accessibility and behavioral operability.

ITHBC-Based Behavioral Intervention Improves Health Outcomes in Multiple Dimensions

The improvement of quality of life is one of the core goals of behavioral intervention. Through psychological counseling (e.g., visualized survival rate data, peer support groups) and health behavior plans (dietary intervention, exercise management), this program significantly improved the quality of life of patients in the intervention group, with a statistically significant difference between the two groups ($P < 0.05$). For example, the "benefit perception" strategy in motivational interviewing (sharing cases with a 5-year survival rate $> 90\%$) directly responded to patients' fear of uncertainty. At the same time, the individualized exercise plan (e.g., 150 minutes of moderate-intensity activity per week) not only reduced fatigue symptoms, but also improved emotional stability through the release of endogenous endorphins. However, attention should be paid to the heterogeneity of quality of life improvement. Some patients had low acceptance of "peer support" due to cultural background differences, suggesting that the intervention needs to be further optimized.

ITHBC-Based Behavioral Intervention Increases Self-Efficacy in Breast Cancer Patients

The improvement of self-efficacy is a psychological hub for behavioral transformation. Through the "selection stage" of motivational interviewing (joint development of SMART goals) and "follow-up support" (regular feedback and adjustment), this study strengthened the sense of control over health behaviors in the intervention group, with a statistically significant difference between the two groups ($P < 0.05$). The goal of "brisk walking 5 times a week" in goal setting conformed to the principle of "progressive success experience" and enhanced implementation confidence through quantifiable indicators. In addition, the stepped risk intervention (monthly follow-up for low-risk patients and weekly intervention for medium-high-risk patients) accurately matched the needs of patients with different self-efficacy levels, which complemented the chronic disease self-management framework proposed by [17]. However, the maintenance of self-efficacy depends on continuous social support. Although the telephone/WeChat follow-up after discharge in this study was practical, the in-depth integration of digital tools (e.g., AI health assistants) may break through the temporal and spatial limitations of traditional interventions. In the future, an AI-driven adaptive intervention system can be further developed to dynamically adjust the difficulty of goals through real-time data analysis, so as to match the changes in patients' psychological status [18].

Conclusion

The phased behavioral intervention based on the ITHBC theory can continuously improve the accuracy of recurrence risk perception in breast cancer patients and promote the

normalization of health behaviors through the synergistic effect of information integration, motivation activation, and self-regulation, thereby improving quality of life and self-efficacy. This program has standardized operation and strong repeatability, and is especially suitable for the rehabilitation nursing of early-stage breast cancer patients, which is worthy of clinical promotion.

Acknowledgments and Disclosures

None.

Conflict of Interest

None.

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