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RESEARCH

The effect of tailored nursing interventions based on the IKAP model on the discharge readiness of the spouses or children of breast cancer patients: a randomized controlled trial

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Abstract

Background Breast cancer is distressing as it affects the whole family. During the course of anti-tumor treatment, it plays a role of crucial significance of the patient's discharge and subsequent home rehabilitation. The home-based rehabilitation of patients after discharge during anti-tumor treatment is closely associated with the matter of whether the next treatment cycle can be initiated smoothly. Nevertheless, the majority of patients and their caregivers are ill-prepared when confronted with multiple requirements, problems, and complex information.

Objective This research aims to investigate the application efficacy of the nursing intervention based on the IKAP model in the discharge readiness of the spouses or children of breast cancer patients, thereby providing a reference basis for clinical nurses to establish a discharge health education intervention model for them.

Methods This research was a randomized controlled trial. From July 2024 to November 2024, 100 spouses or children of breast cancer patients in the Oncology department of a Grade-A tertiary hospital in China were selected and split into an intervention group and a control group($n = 50$ each). The control group received routine health education during hospitalization. The intervention group, after routine education, implemented IKAP-based nursing intervention (info collection, cognitive ed., belief support, behavior int.). Data on discharge readiness, disease uncertainty of caregivers, and patients' quality of life in both groups were collected and analyzed by MMRM at pre-intervention (usually 2nd day after admission), discharge, 3, 6, 9, and 12 weeks.

Results The IKAP-based nursing intervention had a significant positive effect on breast cancer patients' spouses/children, with a significant time interaction effect between groups ($P < 0.001$). From 3—12 weeks post-intervention, the intervention group's caregivers had a significantly higher discharge readiness score (3 weeks: 3.89, 95% CI (2.36, 5.44); 12 weeks: 7.09, 95% CI (5.55, 8.64)) and a significantly lower disease uncertainty score (3 weeks: -6.42, 95% CI (-10.12, -2.72); 12 weeks: -15.46, 95% CI (-19.18, -11.73)). From 6—12 weeks post-intervention, the intervention group's breast cancer patients had a significantly higher quality of life score (6 weeks: 9.62, 95% CI (4.01, 15.22); 12 weeks: 15.58, 95% CI (9.96, 21.19)). The intervention effects of the three indicators improved with increasing intervention time. No adverse events were noted during the study.

Conclusion IKAP-model-based nursing intervention can significantly raise the discharge readiness level of spouses or children of breast cancer patients, reduce their disease uncertainty, and effectively improve the quality of life of breast cancer patients.

Keywords Breast cancer · Caregivers · Discharge readiness · IKAP model · Disease uncertainty · Quality of life

Introduction

Background

In 2022, global cancer statistics revealed that breast cancer cases reached 2.297 million, making it the most common

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cancer among females globally and showing an increasing annual trend [1–3]. In China, it represents the primary malignant tumor burden for females, characterized by a high survival rate, younger age of onset, and a relatively long treatment cycle [4, 5]. The 5-year relative survival rate for Chinese female patients is 82%, with incidence rising rapidly after age 35 [6]. Breast cancer is primarily treated with surgery combined with radiotherapy, chemotherapy, and targeted immunotherapy. Following anti-tumor treatment, patients face numerous challenges, including poor home management of adverse reactions, issues with body image and sexual function, changes in social roles, recurrence, reduced quality of life, and long-term rehabilitation needs [7–10]. These patients have diverse demands during rehabilitation [11–13]. China's policy to shorten hospital stays and increase bed utilization has reduced the time available for discharge preparation for both patients and caregivers [14–16]. Domestic surveys reveal that cancer caregivers generally have medium to low discharge readiness [17–19], which hinders patients'home rehabilitation and negatively affects their mental health and quality of life [20, 21]. Approximately 40%—45% of patients with breast cancer report unmet needs [22, 23]. Spouses and children, as primary caregivers, must provide physical care, offer emotional support, and manage emergencies. Caregivers also experience psychological, physiological, and social pressures, including negative emotions and heightened disease uncertainty [24–27]. Thus, improving caregivers'discharge readiness and addressing patients'rehabilitation challenges is crucial for enhancing overall rehabilitation and quality of life. Urgent attention should be given to the discharge preparation status of caregivers supporting individuals with breast cancer.

Discharge readiness, first proposed by Professor Fenwick in 1979 [28], serves as an intermediary variable for hospital-to-home transition and is a core component of international discharge planning. It is the primary indicator for assessing the readiness of patients and caregivers for discharge and helps medical staff evaluate patients'ability to reintegrate into their family and society, considering physiological, psychological, and social support factors [29]. Discharge readiness encompasses four aspects: physiological stability, social support, psychological coping, and information/knowledge [30]. Research has shown that discharge preparedness is influenced by multiple factors, including the patient's health status, treatment completion, extent of rehabilitation [31], self-care abilities, family and social support integrity, availability of post-discharge medical resources, and the patient's ability to acclimatize post-discharge [32].

In some countries, discharge readiness is well-developed and supported by mandatory health policies and comprehensive community-based continuity service models [33, 34]. Higher discharge readiness enhances patients'post-discharge coping abilities, improves home rehabilitation effectiveness, and reduces unplanned readmission rates, thereby conserving medical resources and alleviating the caregiving burden on patients and their families [35–37]. In China, research on discharge readiness primarily focuses on exploring the current status, analyzing influencing factors, and developing intervention strategies to improve patients'discharge readiness [38–40]. Medical staff typically emphasizes enhancing patients'self-efficacy but often overlook the role of spouses and children as key sources of family social support. Patients and their spouses and children form an inseparable unit [41]. and caregivers serve as a vital source of health information for medical staff [42–47]. However, reports addressing nursing intervention research on the discharge readiness of caregivers for individuals with cancer are scarce, particularly in breast cancer, with significant room for improvement in discharge preparation research within Chinese hospitals [48].

The caregivers of patients with breast cancer require information such as treatment plans, nursing care knowledge, medication management, and follow-up plans from medical staff to ensure effective post-discharge home preparation [49–51]. Studies suggest that high-quality health education and discharge guidance can improve caregivers'understanding of the disease, reinforce their confidence in management, correct harmful behaviors, alleviate negative psychological states, and enhance the quality of life for both patients and caregivers [52]. The Information-Knowledge-Attitude-Practice (IKAP) model is a health education approach in which medical staff provides health education tailored to individual information needs, aimed at building health beliefs and promoting behavior change for health improvement. China has successfully applied this model in chronic disease management, achieving positive outcomes [53–55]. For instance, IKAP-based health education significantly improves pulmonary function in patients with COPD during rehabilitation, enhances'self-management and treatment compliance, and improves their quality of life [56]. It also plays a key role in enhancing the knowledge, beliefs, and behaviors of the primary caregivers of patients with stroke, enriching coping strategies, reducing caregiving stress, and improving overall care capabilities [57].

However, research on the application of the IKAP model for the discharge preparation of caregivers supporting patients with breast cancer is scarce. More effective interventions are needed to support caregivers in home care preparation and to ensure a seamless hospital-to-home transition. This study aimed to examine the impact of the IKAP model-based nursing intervention on the discharge readiness of spouses and children of patients with breast cancer, providing evidence for its clinical application in China and serving as a reference for optimizing health education models for caregivers in clinical nursing.

Objectives

This study focused on assessing the impact of the IKAP model-based nursing intervention on the discharge readiness of spouses and children of patients with breast cancer. The goals include enhancing the caregiving capacity of these caregivers, decreasing their disease-related uncertainty, minimizing patient complications during anti-tumor treatment, improving the quality of life for patients with breast cancer, and facilitating their reintegration into family and social roles. The following benefits are provided to patients with breast cancer and their caregivers.

1. Evaluating the effectiveness of implementing the IKAP model in improving the discharge readiness of patients with breast cancer and their spouses and children.
2. Investigating the temporal variations and specific impacts of the IKAP model-based nursing intervention at different time points when applied to the spouses and children of patients with breast cancer

Methods

Design

This was a randomized controlled clinical trial study conducted in a large Grade-A tertiary public hospital in south China. The research subjects (spouses or children of breast cancer patients) who met the inclusion criteria and were admitted to the hospital from July 1, 2024 to November 1, 2024 were randomly divided into an intervention group and a control group. The intervention group adopted nursing intervention for discharge readiness based on the IKAP model on the basis of the conventional nursing management model. The intervention had lasted for a total of 12 weeks. And the intervention measures included setting up a discharge readiness service team based on the IKAP model, formulating a personalized discharge readiness intervention plan, and conducting information collection, cognitive education, belief support, behavior intervention and continuous care for spouses or children of breast cancer patients (caregivers for short). Besides, the indicators were collected six times listed as before the intervention (the second day after the admission to the hospital), at the intervention time nodes (on the day of discharge, 3 weeks, 6 weeks, 9 weeks and 12 weeks). The content of collection included the discharge readiness indicators of spouses or children of breast cancer patients, the disease uncertainty indicators and the quality of life measurement indicators of breast cancer patients. During the intervention period, it had been evaluated weekly of the enrollment rate of research subjects and the completion rate of nursing intervention measures. Lastly, the research protocol of this study has been registered on the official website of the Chinese Clinical Trial Registry (registration number: ChiCTR2400089956).

Sample

Inclusion criteria

The inclusion criteria of this study are as follows: ① The research subjects are limited to the spouses or children of breast cancer patients who are admitted to the hospital for the first or second time (as caregivers of breast cancer patients with more than two hospitalization experience have basically understood and mastered the relevant contents of disease treatment and care, which will interfere with the analysis of clinical data), and the expected survival period of the patients is $\geq$6 months. ② The age of the spouses or children is 18—65 years old. ③ Those who volunteer to participate in this study and can cooperate throughout the process, and sign the informed consent form. ④ Be capable of normal communication. ⑤ Be the main caregiver of the patient, with a length of more than 40 h per week of caring time and the expected length of caring time is $\geq$6 months. ⑥ The spouses or children are in good health.

Exclusion criteria

The exclusion criteria of this study are as follows: ① The patient or the caregiver has a previous history of mental illness or a family history of mental disorders; ② The patient has other serious diseases; ③ There is more than one care—receiving person; ④ The caregiver has severe underlying diseases.

Power analysis

By means of the software tool of PASS v15.0 to calculate the sample size, with a two-tailed test is adopted, the discharge readiness score of the research subjects is the main observed outcome indicator. According to literature review and the results of the pilot experiment, the average discharge readiness score of the control group is (18.65 $\pm$ 3.03) points, and the average discharge readiness score of the intervention group is (20.30 $\pm$ 0.78) points. Set two-sided $\alpha = 0.05$, the power is 90%, and the dropout rate is 20%. The overall variance $\sigma 2$ is estimated using the sample variance S^2. And the sample size is calculated by the following formula:

$$n = \frac{2(Z_\alpha + Z_\beta)^2 * \sigma^2}{\delta^2}$$

$$S^2 = \frac{{S_1}^2 + {S_2}^2}{2}$$

Finally, it is calculated that N1 = N2 = 50, that is, 50 people in the intervention group and 50 people in the control group. And the total sample size is 100 people.

Randomization

At the beginning of the research, our staff had received adequate and unified training. A researcher who had no contact with the research subjects randomly grouped the research subjects in a 1:1 ratio according to the method of random number table (the patients who met the inclusion and exclusion criteria were numbered according to the order of admission. A number was randomly selected from the random number table, and the corresponding random numbers were obtained in sequence from left to right. The random number was divided by 2 and the remainder was calculated. If it was divisible, the patient with the corresponding discharge number entered the control group; otherwise, the patient entered the intervention group). The research subjects of the two groups were placed in the wards at both ends of the ward area respectively to ensure that the research subjects in the same ward were in the same research group and to avoid the confusion of mixed samples.

Procedure

Intervention and usual care

Control group: During the hospitalization of the patient, the conventional nursing model had been adopted: ①Implementing conventional nursing measures of breast cancer for the patient during hospitalization; ②Distributing corresponding health booklets (including the information about admission and discharge booklets, myelotoxicity, cancer—related pain, catheters carried on the body, nausea and vomiting, etc.) for cancer treatment according to the patient's condition; ③Answering the questions of breast cancer patients, spouses or children; ④Providing diet guidance and knowledge guidance on prevention and treatment of potential risks after discharge for breast cancer patients; ⑤Assisting in handling discharge; ⑥Conducting routine follow-up after discharge.

Intervention group: During the hospitalization of the patient, the same conventional nursing model had been adopted as well.

Meanwhile, on top of the conventional nursing model, tailored nursing intervention for discharge readiness based on the IKAP model had been applied to the caregivers:

(1) Establish a service team for discharge readiness based on the IKAP model: including oncologists, oncology nurses, psychological counselors, educational nurses, rehabilitation instructors related to breast cancer, etc. With obtained specialized certificates, all members of the team had been allocated according to their specialized natures, and their responsibilities and division of labor were clarified after conducting unified training ahead of the research.
(2) Implement intervention measures(tailored nursing intervention for discharge readiness based on the IKAP model) (Table 1):

Data collection

(1) Data collection: The investigators distributed paper questionnaires one by one to those who met the inclusion criteria and explained the research content and filling methods to them. The survey had been conducted at a time when the research subjects had stable condition and emotion, and they were willing to communicate with investigators, who had assisted the research subjects in filling out the questionnaires independently. For participants with lower educational levels or difficulties in writing, the investigators could fill in the questionnaires objectively and truthfully on their behalf after sufficiently communicating with them. After completing the questionnaire, the investigators should immediately collect the questionnaire and check and verify it in time. If there were omissions or errors in filling, they should confirm and correct them with the research subject in time to ensure the integrity and quality of the questionnaire filling.
(2) Data input: Following the double-blind trial rule, two investigators were responsible for the collection conduct data entry and verification of the paper questionnaire, and then they inputted the collection into Excel software equally, and random check was held over strictly. When inconsistent data was found, the researcher would carefully check the original data and correct that. After the data input is finished, another special person checked it again to ensure the validity and authenticity of the data.
(3) Data storage: The paper questionnaires were stored in a locked filing cabinet, and the electronic data was stored in a computer and mobile hard drive with passwords to prevent data loss and ensure the security of the data.

Measures

(1) General Information Questionnaire: The research team independently compiled the"Basic Information Questionnaire on Readiness for Discharge of Breast Cancer Patients (Spouses or Children of Breast Can-

Table 1 Personalized nursing interventions based on the IKAP model

Occasions	Ways	Contents		Objects
Within 24 h of admission to the hospital	Inquiry	Information collection	①The information of the research subjects was comprehensively grasped: the relationship with the patients, educational level, physical condition, average daily care duration, etc	Through detailed information collection, evaluate the individualized needs of the research subjects
	Introduction		②The doctor in charge of the main diagnosis team, the responsible nurse, the ward environment and facilities were introduced to the research participants, who were also notified of the procedures for checking and paying fees, the way of ordering meals and the necessary items. Simultaneously, education regarding risk prevention was carried out, the significance of role transformation and role adaptation was informed, which could help them quickly become familiar with the ward and eliminate the sense of strangeness	
	Assessment		③The cooperation level and the attitudes of the research participants regarding the trial had been evaluated, and the subjects were randomly assigned to groups, to whom the purpose, content, and precautions of the project research to the research subjects, and sign an informed consent form had been explained. Through detailed information collection, the health education needs of the research subjects were assessed, and then we formulated a personalized discharge readiness intervention plan. When personal files were established, patients and caregivers started to fill out the general information questionnaire in the exclusive research manual	
From the second day of admission to the day before discharge	Implementation of the Plan	Cognitive education	④According to the personalized intervention plan, one-on-one, group learning and special knowledge lectures given by breast cancer specialists were adopted, and relevant knowledge education was carried out in a targeted manner. Several forms such as explanation, demonstration, and guided reading were used to conduct training on breast cancer about anti-tumor treatment-related knowledge and nursing skills for the spouses or children of patients, including: knowledge guidance on adverse reactions of anti-cancer treatment, nutritional diet guidance, functional rehabilitation exercise, activity assistance, medication guidance, skin and wound care, catheter care, psychological support, family structure reorganization, planning for home life after discharge and how to adapt to normal life as a role of caregiver, etc	Through systematic education and training, enhance the knowledge level of the research subjects

Table 1 (continued)

Occasions	Ways	Contents		Objects
		Belief support	⑤Relying on the"Self-Efficacy Cheering Station"project of our department, belief support was provided in the forms of individual education, group education, expert symposiums, and sharing of exemplary cases. A team composed of oncology specialist nurses, breast cancer specialist doctors, and psychotherapists provided psychological counseling to the spouses or children of breast cancer patients, which helped to eliminate negative emotions, establish a strong belief, and enhance their future confidence. Family members who were proficient in breast cancer care knowledge and skills were invited to share their nursing experiences and encourage the exchange of heartfelt feelings, talk about the difficulties they encounter in the process of caring for breast cancer patients to express negative emotions, and relieve stress	Provide psychological support to enhance the family members'sense of trust and belief in nursing
		Behavioral intervention	⑥It was carried out on the research subjects through diverse forms such as role-playing, empathy, and seeing from others'perspectives. The training content included the identification and response to adverse reactions of anti-tumor treatment, common nursing skill training and assessment, role transformation, training on access to breast cancer care knowledge, self-psychological counseling, and self-healthy lifestyle. Besides, the responsible nurse repeatedly demonstrated the skills that must be mastered and provided guidance until the caregivers were proficient. The relevant learning content were made into a remote learning and education package for facilitate caregivers to re-consult and study at home, including videos, PPT, text materials, process guidelines, etc	Improve the nursing behaviors and skills of the research subjects and enhance their practical operation abilities through training
From the day of discharge to three months after discharge	Telephone, We-chat, and the hospital's follow-up data platform	Continuous nursing	⑦Follow-up was conducted on the spouses or children of breast cancer patients on the 3rd and 7th days after discharge and weekly thereafter, and targeted guidance was provided and deviations were corrected. As for the follow-up content, it included the patient's situation (disease changes after anti-tumor treatment, diet and activity status, psychological status, etc.) and the caregivers'situation (mastery and implementation of nursing skills, adaptability, role transformation status, psychological status, physiological status, application of access to information channels, etc.). And we had arranged a special person to be on duty in the We-chat communication group to answer the questions raised by the research subjects in a timely manner	Ensure continuous nursing and support after discharge and that family members can handle emergency situations

cer Patients)"after literature retrieval and discussion. Data collectors used unified guiding language to collect demographic information of research subjects, including age, gender, marital status, educational level, work status, monthly income, etc. In this research, the research subjects completed the questionnaire survey as independently as possible. And for those who could not fill in the form in person, data collectors would fill in the form truthfully according to the description of the research subjects.

(2) Caregiver preparedness: The Caregiver Preparedness Scale (CPS) was developed by Archbold [58] et al. in the United States and was sinicized by scholars such as Liu Yanjin [59] in China. This scale is used to evaluate caregivers'perception of their preparedness to care for the patients. It is a unidimensional scale and contains eight items: caring for the patient's physiological needs, emotional needs, making service plans for the patient, coping with the pressure of taking care of the patient, providing considerate care for the patient, coping with and managing emergencies, obtaining help and information resources from the medical care system, and overall preparedness of care. Each item is scored through a Likert 5-point scoring method, ranging from 0 points for"extremely inconsistent"to 4 points for"highly consistent". And the total score ranges from 0 to 32 points. The higher the score, the more fully prepared the caregiver is for looking after the patient. The Cronbach's α coefficient of this scale is 0.93.

(3) Disease uncertainty of the family members: The Parent's Perception Uncertainty Scale-Family (PPUS-FM) was originally developed by Mishel, an American nursing expert. In this research, the Chinese version translated and revised by Cui Hongyan [60] was adopted, which included four dimensions, namely uncertainty, complexity, lack of information, and unpredictability. Generally, the scale had a total of 30 items, and each item was scored using a Likert 5-point scoring method, ranging from 1 point for"strongly agree"to 5 points for"strongly disagree". Among them, a total of 10 items need positive scoring, which includes No. 6, 9, 11, 19, 23, 25, 27, 28, 30, and 31, and the rest of them needed to be scored conversely. The total score ranged from 30 to 150 points. The higher the score, the stronger the individual's disease uncertainty. When the score of disease uncertainty was greater than 75 points, the individual would be considered to have a relatively high level of disease uncertainty. The Cronbaeh's α coefficient of this scale was 0.85 in the population of family members of cancer patients, according to the thesis of Hu Xiaoyan [61] and others.

(4) Assessment of the quality of life of breast cancer patients: The Quality of Life Instruments for Cancer Patients-Breast Cancer (QLICP-BR) was developed by Yang Zheng [62] et al. This scale included a total of 39 items in 5 dimensions, namely physical function (7 items), psychological function (12 items), social function (6 items), common symptoms of diseases (7 items), and breast cancer-specific module (7 items). Each item was scored using a Likert 5-point scoring method, ranging from 1 point for"nowise"to 5 points for"extremely". Positive items were directly scored from 1 to 5 points, while reverse items were scored to the contrary. The total score ranges from 39 to 195 points, the higher the total score, the better the quality of life of the patient. The Cronbach's α coefficient of this scale was 0.84.

Data analysis

Through the principle of ITT(Intention-To-Treat), researchers conducted statistical analysis on all research subjects who met the protocol requirements and were input into the research through random grouping, and then the intervention (including the evaluation of dropped research samples) was initiated to evaluate the overall treatment effect. According to the type of clinical intervention data, appropriate statistical methods were adopted: categorical variables were described by frequency (percentage); if continuous variables were approximately symmetrically distributed, they were described by mean ± standard deviation; otherwise, they were described by median (inter-quartile range). For comparison of differences between intervention group and control group (including basic data and outcome indicators), Pearson's Chi-square Test or Fisher's Exact Probability Test were used for categorical variables. If continuous variables were approximately normally distributed, t-test was applied to the comparison of differences between groups. Otherwise, Wilcoxon Rank Sum Test was used. Mixed Model for Repeated Measures was used to compare the effects of intervention measures, whether the outcome indicators changed over time, and whether the changing trends of the two groups were the same. If the proportion of missing data was not more than 30%, the same model was run after using the MCMC (Markov chain Monte Carlo) method to multiply impute the data; otherwise, the individual data with missing values were deleted. A P value < 0.05 was considered statistically significant.

Ethics considerations

This research was conducted in accordance with the *Declaration of Helsinki*. All research subjects signed a written informed consent form before participating in the

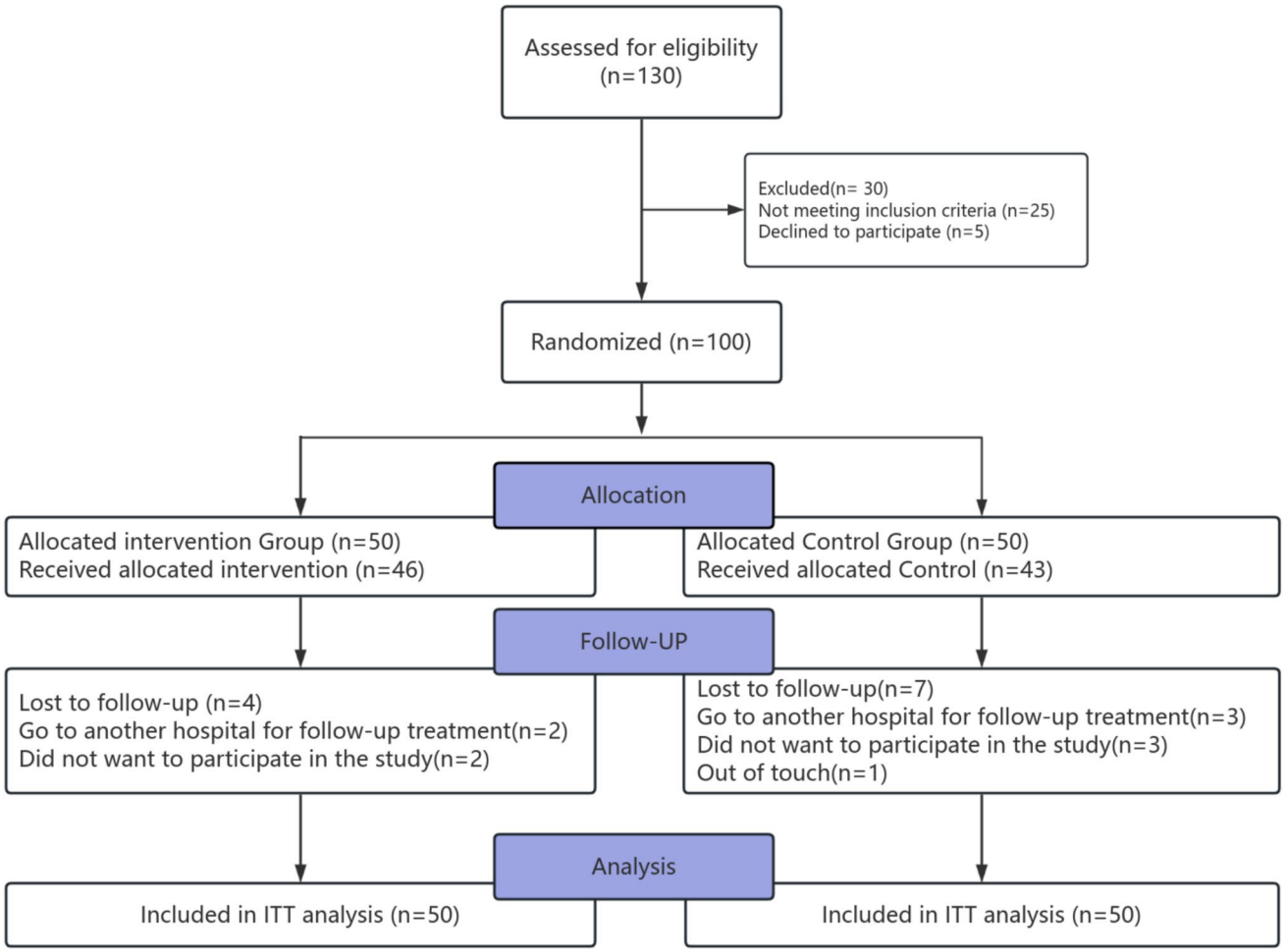

Fig. 1 A flow chart of the research process

research. All matters in this research was strictly voluntary, confidential, fair, beneficial and safe. It had been registered in the National Medical Research Registration and Information System and approved by the medical ethics committee (Ethical review batch number: Peking University Shenzhen Hospital Ethics Review (Research) [2024] No. (101)).

Results

Participant characteristics

A total of 100 spouses and children of patients with breast cancer were included in this study, with 50 in the intervention group and 50 in the control group. All participants completed the general information survey. Among the 100 caregivers, 35 were aged 18–39, 55 were aged 40–59, and 10 were aged 60–65. Ninety percent of caregivers were either young or middle-aged. Among the caregivers, 85 were male and 15 were female, with males constituting 85% of the total. All the patients in this study were female (100 cases). During the study, 11 caregivers dropped out, including four from the intervention group and seven from the control group. Ultimately, 89 caregivers completed the 12-week intervention, including 46 in the intervention group and 43 in the control group (Fig. 1). No statistically significant differences were found in general characteristics such as sex, age, and education level between the two groups of research ($P > 0.05$) (Table 2).

Comparison of the total discharge-readiness score between caregivers in the two groups

Before the intervention, no statistically significant difference was found in the total discharge-readiness scores between the two groups ($P > 0.05$). After the intervention, a time interaction effect was observed in the total discharge-readiness scores of caregivers in both groups ($P < 0.001$). On the day of discharge, no significant difference was found in

Table 2 Socio-demographic and clinical characteristics at baseline after allocation between the two groups

Socio-demographic and clinical characteristics of caregivers				
Baseline Value	Level	Overall($N=100$)	Intervention Group($N=50$)	Control Group($N=50$)
Age (%)	18–39	35 (35.0)	21 (42.0)	14 (28.0)
	40–59	55 (55.0)	24 (48.0)	31 (62.0)
	60–65	10 (10.0)	5 (10.0)	5 (10.0)
Gender (%)	Male	85 (85.0)	42 (84.0)	43 (86.0)
	Female	15 (15.0)	8 (16.0)	7 (14.0)
Ethnicity (%)	Han nationality	99 (99.0)	49 (98.0)	50 (100.0)
	Others	1 (1.0)	1 (2.0)	0 (0.0)
Place of residence (%)	Urban	90 (90.0)	45 (90.0)	45 (90.0)
	Rural	10 (10.0)	5 (10.0)	5 (10.0)
Work status (%)	Worker	16 (16.0)	6 (12.0)	10 (20.0)
	Freelancer	26 (26.0)	13 (26.0)	13 (26.0)
	Personnel of enterprises and institutions	38 (38.0)	22 (44.0)	16 (32.0)
	Unemployed	8 (8.0)	4 (8.0)	4 (8.0)
	Others	12 (12.0)	5 (10.0)	7 (14.0)
Marital status (%)	Married	90 (90.0)	43 (86.0)	47 (94.0)
	Unmarried	10 (10.0)	7 (14.0)	3 (6.0)
Education level (%)	Junior high school and below	16 (16.0)	7 (14.0)	9 (18.0)
	High school/vocational high school/technical secondary school	22 (22.0)	10 (20.0)	12 (24.0)
	Junior college/undergraduate and above	62 (62.0)	33 (66.0)	29 (58.0)
Relationship with patient (%)	Spouse	73 (73.0)	35 (70.0)	38 (76.0)
	Children	27 (27.0)	15 (30.0)	12 (24.0)
Religious belief (%)	None	97 (97.0)	48 (96.0)	49 (98.0)
	Yes	3 (3.0)	2 (4.0)	1 (2.0)
Monthly income (%)	Below 3,000	13 (13.0)	8 (16.0)	5 (10.0)
	3,000—5,000	16 (16.0)	9 (18.0)	7 (14.0)
	5,000—8,000	14 (14.0)	6 (12.0)	8 (16.0)
	8,000—15,000	35 (35.0)	18 (36.0)	17 (34.0)
	15,000—30,000	17 (17.0)	8 (16.0)	9 (18.0)
	Above 30,000	5 (5.0)	1 (2.0)	4 (8.0)
Frequency of caring (%)	2 days and below	7 (7.0)	5 (10.0)	2 (4.0)
	3—4 days/week	6 (6.0)	1 (2.0)	5 (10.0)
	Almost every day	87 (87.0)	44 (88.0)	43 (86.0)
Socio-demographic and clinical characteristics of breast cancer patients				
Baseline Value	Level	Overall($N=100$)	Intervention Group($N=50$)	Control Group($N=50$)
Age (%)	18–39	15 (15.0)	8 (16.0)	7 (14.0)
	40–59	67 (67.0)	36 (72.0)	31 (62.0)
	≥60	18 (18.0)	6 (12.0)	12 (24.0)
Patient's disease stage (%)	Stage I	26 (26.0)	9 (18.0)	17 (34.0)
	Stage II	45 (45.0)	24 (48.0)	21 (42.0)
	Stage III	14 (14.0)	10 (20.0)	4 (8.0)
	Stage IV	15 (15.0)	7 (14.0)	8 (16.0)
Ethnicity (%)	Han nationality	99 (99.0)	49 (98.0)	50 (100.0)
	Minority nationality	1 (1.0)	1 (2.0)	0 (0.0)
Place of residence (%)	Urban	85 (85.0)	42 (84.0)	43 (86.0)
	Rural	15 (15.0)	8 (16.0)	7 (14.0)

Table 2 (continued)

Work status (%)	Farmer	2 (2.0)	1 (2.0)	1 (2.0)
	Worker	9 (9.0)	4 (8.0)	5 (10.0)
	Freelancer	12 (12.0)	3 (6.0)	9 (18.0)
	Personnel of enterprises and institutions	20 (20.0)	11 (22.0)	9 (18.0)
	Unemployed	33 (33.0)	16 (32.0)	17 (34.0)
	Others	24 (24.0)	15 (30.0)	9 (18.0)
Marital status (%)	Married	93 (93.0)	45 (90.0)	48 (96.0)
	Unmarried	1 (1.0)	1 (2.0)	0 (0.0)
	Divorced	2 (2.0)	1 (2.0)	1 (2.0)
	Widowed	4 (4.0)	3 (6.0)	1 (2.0)
Education level (%)	Junior high school and below	40 (40.0)	19 (38.0)	21 (42.0)
	High school/vocational high school/technical secondary school	24 (24.0)	13 (26.0)	11 (22.0)
	Junior college/undergraduate and above	36 (36.0)	18 (36.0)	18 (36.0)
Religious belief (%)	None	96 (96.0)	48 (96.0)	48 (96.0)
	Yes	4 (4.0)	2 (4.0)	2 (4.0)
Monthly income (%)	Below 3,000	47 (47.0)	21 (42.0)	26 (52.0)
	3,000—5,000	17 (17.0)	12 (24.0)	5 (10.0)
	5,000—8,000	11 (11.0)	4 (8.0)	7 (14.0)
	> 8,000	25 (25.0)	13 (26.0)	12 (24.0)
Payment method (%)	Local medical insurance	58 (58.0)	30 (60.0)	28 (56.0)
	Off-site medical insurance	42 (42.0)	20 (40.0)	22 (44.0)
Self-care ability (%)	Fully self-care	91 (91.0)	46 (92.0)	45 (90.0)
	Partially self-care	9 (9.0)	4 (8.0)	5 (10.0)
Chemotherapy course (%)	3	1 (1.0)	0 (0.0)	1 (2.0)
	4	14 (14.0)	6 (12.0)	8 (16.0)
	5	2 (2.0)	1 (2.0)	1 (2.0)
	6	25 (25.0)	15 (30.0)	10 (20.0)
	8	40 (40.0)	17 (34.0)	23 (46.0)
	12	3 (3.0)	2 (4.0)	1 (2.0)
	14	1 (1.0)	1 (2.0)	0 (0.0)
	17	1 (1.0)	0 (0.0)	1 (2.0)
	18	8 (8.0)	6 (12.0)	2 (4.0)
	NA	5 (5.0)	2 (4.0)	3 (6.0)

the total discharge-readiness scores of caregivers between the two groups. At 3, 6, 9, and 12 weeks of intervention, the total scores for the intervention group were 23.7 ± 3.78 and 29.28 ± 2.19, respectively (Table 3). The total discharge-readiness score of caregivers in the intervention group was significantly higher than that in the control group. As the intervention period progressed, the effect showed an upward trend. The effect values were 3.89 (2.36, 5.44) at 3 weeks, 5.21 (3.67, 6.76) at 6 weeks, 5.85 (4.30, 7.39) at 9 weeks, and 7.09 (5.55, 8.64) at 12 weeks, indicating that nursing intervention based on the IKAP model increased the average discharge-readiness score by 7.09 at 12 weeks. The outcomes remained stable (Fig. 2).

Comparison of the disease-uncertainty scores between caregivers in the two groups

Before the intervention, no statistically significant difference was observed in disease-uncertainty scores between the two groups of caregivers ($P > 0.05$). After the intervention, a time interaction effect was observed on the total score of disease uncertainty in the two groups ($P < 0.001$). On the day of discharge, no difference in disease uncertainty was observed between the two groups. At 3, 6, 9, and 12 weeks of intervention, the total disease-uncertainty scores in the intervention groups were 73.62 ± 9.34, 57.9373.62 (Table 3). Disease uncertainty of caregivers in the intervention group was significantly lower than that in the control group. As

Table 3 Total score of discharge readiness, disease uncertainty and quality of life of patients and scores of each dimension (X ± S)

Subtitle	Group	Before intervention	On discharge day	3 weeks	6 weeks	9 weeks	12 weeks
The total score of caregivers'discharge readiness	Intervention	18.22 ± 4.03	20.79 ± 3.46	23.7 ± 3.78	25.63 ± 3.71	27.11 ± 3.28	29.28 ± 2.19
The total score of caregivers'discharge readiness	Control	18.46 ± 4.51	19.33 ± 4.71	19.87 ± 4.12	20.41 ± 3.74	21.07 ± 3.4	22 ± 3.49
The total score of caregivers'perception of disease uncertainty	Intervention	86.02 ± 9.43	79.62 ± 7.41	73.62 ± 9.34	67.59 ± 8.96	62.04 ± 8.9	57.93 ± 9.04
The total score of caregivers'perception of disease uncertainty	Control	84.94 ± 10.43	81.41 ± 10.71	79.91 ± 8.58	77.39 ± 9.04	75.35 ± 8.73	73.67 ± 8.6
The total score of patients'quality of life	Intervention	146.68 ± 15.28	148.58 ± 12.83	154.32 ± 11.07	160.33 ± 11.1	165.24 ± 10.72	168.91 ± 9.25
The total score of patients'quality of life	Control	148.18 ± 16.47	147.78 ± 15.82	150.02 ± 14.62	150.77 ± 15.11	151.88 ± 15.64	153.3 ± 14.61

the intervention period progressed, a downward trend was observed. The effect values were −6.42 (−10.12, −2.72) at 3 weeks, −9.78(−13.50, −6.07) at 6 weeks, −13.02(−16.75, −9.3) at 9 weeks and −15.4 (−19.18, −11.73) at 12 weeks, indicating that nursing intervention based on the IKAP model reduced the disease-uncertainty score by an average of 15.46. The outcomes remained stable (Fig. 2).

Comparison of quality-of-life scores between patients with breast cancer in the two groups

Before the intervention, no statistically significant difference was observed in the total scores for general information and quality of life between the two groups of patients with breast cancer ($P > 0.05$). After the intervention, a time interaction effect was observed in the quality of life scores in both groups ($P < 0.001$). At discharge and 3 weeks post-intervention, no differences in quality of life scores were observed between the two groups; However, at 6, 9, and 12 weeks of intervention, quality of life scores in the intervention group were 160.33 ± 11.1, 165.24 ± 10.72, and 168.91 ± 9.25 respectively (Table 3). The quality of life scores in the intervention group were significantly higher than those in the control group. As the intervention time progressed, the effect showed an upward trend. The effect values were 9.62 (4.01, 15.22) at 6 weeks, 13.32 (7.71,18.93) at 9 weeks, and 15.58 (9.96, 21.19) at 12 weeks, indicating that nursing interventions increased the average quality of life score in the intervention group by 15.58. The outcomes remained stable (Fig. 2).

Discussion

In this study, the discharge readiness of the spouses and children of patients with breast cancer in both groups was at a medium level before the intervention, with caregivers experiencing a high sense of disease uncertainty. The nursing discharge-readiness intervention program was developed using the IKAP model, involving a 12-week intervention for the caregivers. Following the main steps of the IKAP model, the information needs of the caregivers were assessed, and a tailored research manual was developed. Next, an individualized intervention plan was developed. Through health education, caregivers were provided with knowledge about patient care, enhancing their confidence in managing caregiving responsibilities and emphasizing their critical role in supporting patients. Remote learning resources and education packages were provided to caregivers to promote healthy caregiving behaviors, with professional nurses offering follow-up support for comprehensive discharge preparation. The main findings of this study demonstrate that intervention measures based on the IKAP model were effective for health education and discharge guidance for the caregivers of individuals with breast cancer. After 3 weeks of intervention, caregivers'discharge preparedness significantly improved. Additionally, the intervention notably reduced caregivers'sense of disease uncertainty to a lower level and correspondingly improved the quality of life of patients with breast cancer after 6 weeks of intervention. The intervention effect continued to increase significantly with extended intervention time.

First, analysis of the caregivers'general information revealed that 90% were young or middle-aged, with male caregivers comprising 85% of the total. All patients with

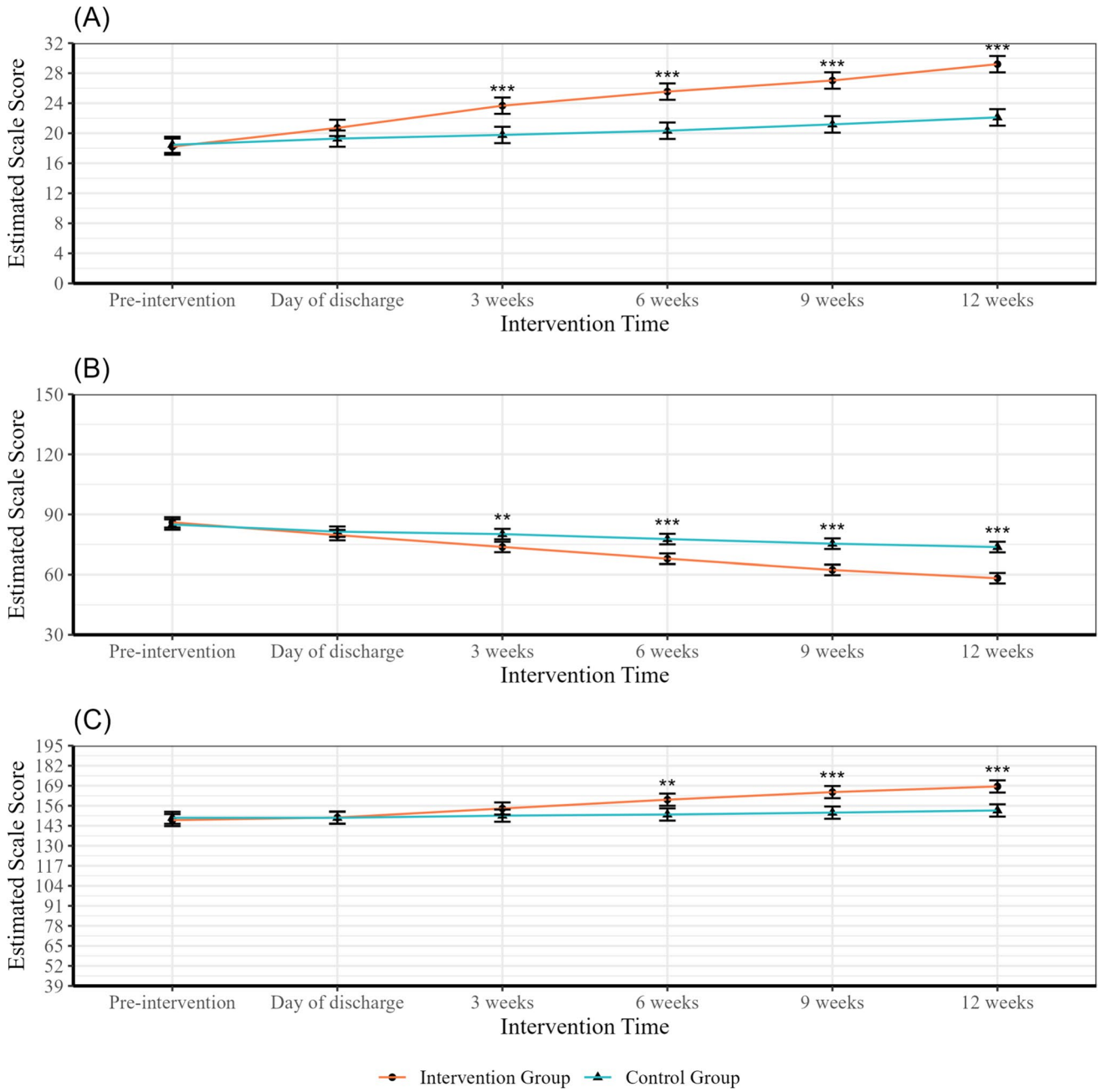

Fig. 2 Situation of time interaction effect in two groups ("***" indicates $P<0.001$, "**" indicates $P<0.01$, "*" indicates $P<0.05$); **A** indicates "The total score of caregivers'discharge readiness", **B** indicates "The total score of caregivers'perception of disease uncertainty", **C** indicates "The total score of patients'quality of life"

breast cancer cared for by caregivers were females (100 cases). This is because breast cancer represents the primary disease burden for women, with male caregivers becoming the main caregivers in these families. Zhu Ping et al. [63] found in qualitative research that male caregivers of patients with breast cancer, as a distinct group, require intensified health education from medical staff during the early stages of patient care. Second, before the intervention and on the day of discharge, no significant difference was observed in discharge preparedness between the two groups. This may be because the research participants were caregivers of patients with breast cancer admitted to the hospital for the first or second time. Given the short intervention time from admission to discharge, caregivers were unable to fully receive the IKAP model intervention, making it challenging for them to adapt to their new role, assume caregiving responsibility, and fully master disease-related knowledge. Consequently, the intervention effect was not significant, consistent with

the findings of White et al. [64]. However, after 3 weeks of intervention, the total discharge preparedness scores of caregivers in the intervention group were significantly higher than those in the control group, with scores in each dimension also showing significant improvement. This result was closely linked to the content IKAP model-based intervention, which included information, knowledge, belief, and behavior. Third, by developing service plans for caregivers, they were assisted in reducing their stress, managing emergencies encountered during patient care, and accessing support and information from the healthcare system, significantly enhancing the discharge preparedness of caregivers of patients with breast cancer. As the duration of the intervention increased, its effect also became significantly more pronounced. This may be because primary family caregivers often experience anxiety and nervousness when initially confronted with a breast cancer diagnosis. However, as the course of breast cancer treatment progressed and medical staff provided repeated discharge guidance, caregivers gradually acquired knowledge about the disease, its treatment, and patient care. The knowledge and skills improved over time, and this improvement corresponded with enhanced discharge preparedness. This suggests that medical staff should initiate discharge plans and goals as soon as the patient is admitted, allowing early intervention in caregiver preparedness. Fourth, the results of the secondary indicators showed that disease-related uncertainty scores in the intervention group were significantly lower than those in the control group. This could be due to caregivers acquiring sufficient information and knowledge, which reduced their likelihood of feeling confused. Their sense of uncertainty diminished when they encountered complex disease-related changes or unpredictable adverse reactions. Furthermore, as time passed and caregivers gained experience, they became better equipped to handle caregiving challenges and seek assistance when needed. Therefore, medical staff should enhance family-centered discharge plans, provide personalized services tailored to each family's circumstances, deliver targeted health-related education, and focus on both the content and techniques of guidance. This approach ensures that patients and their families receive an integrated and continuous care plan during hospitalization and post-discharge, facilitating their adaptation to life after discharge. Finally, the quality of life of patients with breast cancer in the intervention group was significantly higher than that of the control group after 6 weeks of intervention, indicating that improved caregiver discharge preparedness and reduced disease-related uncertainty may not have an immediate impact on the patient's quality of life. The likely reason is that, although the IKAP model-based intervention improved various aspects of the caregivers'well-being, the physical, psychological, social, and spiritual traumas caused by the disease and the antitumor treatment endured by patients with breast cancer could not be resolved within a short period. Continuous intervention was essential for them to achieve meaningful benefits. Caregivers of patients with breast cancer need to develop long-term, comprehensive care behaviors and fulfill their critical role as primary caregivers. This involved providing physical, psychological, and social support, managing adverse reactions, and helping patients improve their quality of life.

The participants in this study were caregivers assisting patients hospitalized for the first or second time. Prior to the intervention, the caregivers'discharge preparedness was at a moderate level, consistent with findings by Fu Yongmei [65] concerning caregivers of middle-aged and older patients with lung cancer. However, in this study, the improvement in the discharge preparedness level of caregivers after the intervention was more significant than the results in their research. Before the intervention, caregivers experienced significant disease-related uncertainty. In the qualitative research on caregivers of patients with cancer pain, Li Jiaqi26 found that caregivers at the first hospitalization stage had a strong need for disease treatment and related information. They lacked disease-related knowledge, struggled with symptom recognition, management, and response capabilities, and were in a poor state. At this stage, caregivers often urgently sought more information about the treatment of breast cancer. Conventional health education and nursing intervention were predominantly targeted at the patients. Moreover, research regarding the discharge preparedness of the main caregivers has primarily focused on the analysis of influencing factors, with relatively few studies examining intervention strategies. Shan Ying et al. [66] found that inviting caregivers in intervention measures and providing empowerment education focused on primary family caregivers of patients with cervical cancer patients enhanced patients'self-efficacy, coping styles, self-management abilities, and discharge preparedness. However, this study did not address the varied needs of different families. In this study, after admission, caregivers were provided with detailed treatment information, guided on ways to access relevant knowledge, and engaged through active communication to address their lack of information. Nie Yixuan et al.39 found that implementing a discharge preparation service program for older patients with lung cancer, based on the dual-disease management theory, not only improved patients'discharge preparedness and spousal coping but also met the comprehensive needs of caregivers. However, their observation period was limited to just 1 month after discharge. The information needs of spouses and children of patients with breast cancer varied over time and with changes in the patient's treatment methods. The IKAP model intervention program was designed to assess the caregivers'needs at various stages and develop individualized intervention plans to positively impact caregivers'discharge preparedness. This finding aligns with findings by Zhu Xiaojia et al. [67] who found that discharge

preparation services based on the Timing It Right Framework (TIRF) met the dynamic needs of the caregivers of patients with Alzheimer's and enhanced their care preparedness. The intervention program in this study had greater applicability.

In this study, as the intervention duration increased, the discharge preparedness of the spouses and children of patients with breast cancer in the intervention group, along with the patients'disease-related uncertainty and quality of life, progressively improved. This demonstrated that the nursing intervention had a significant impact on both patients and their caregivers. In the future, the intervention period should be extended to continuously monitor its effects, and the interaction between caregivers and patient outcomes can be further explored. Furthermore, a more scientific and detailed discharge preparation intervention plan should be developed by analyzing the factors influencing the discharge readiness of caregivers of patients with breast cancer.

Currently, intervention modalities for discharge readiness in China are underdeveloped and lack standardization. Discharge planning is recommended to begin upon hospital admission, comprising four steps: assessment, formulation, implementation, and evaluation. Barriers to any of these steps may result in inadequate discharge readiness among study participants. In the future, multidisciplinary team collaboration should be strengthened to facilitate the joint development of discharge plans. Additionally, a discharge-readiness service model tailored to China's national context should be developed by standardizing discharge criteria.

Limitations

This study had some limitations. First, the study included only the spouses and children of patients with breast cancer from a single hospital, limiting both the sampling scope and sample size. Second, due to limited human and material resources, the intervention lasted only 3 months, preventing assessment of the long-term efficacy of the program. Future studies should involve multicenter collaboration, include a more diverse population, extend the intervention period, and examine the long-term effects and optimal implementation strategies for the IKAP model.

Conclusions

A literature review revealed that most studies focused on interventions targeting patients, such as improving their self-efficacy. In this study, spouses and children were selected as the participants because, as the primary family support for patients, they required attention and assistance from medical staff. A discharge-preparedness nursing intervention program based on the IKAP model was developed. Specifically, a discharge preparedness service team based on the IKAP model was established, the health education needs of the participants during anti-tumor treatment were assessed, and an individualized intervention plan was developed. The spouses and children of patients with breast cancer underwent a sequential intervention process, including cognitive education, belief support, behavior intervention, and continuous care. After the intervention, the discharge preparedness of spouses and children of patients with breast cancer improved, their sense of disease uncertainty decreased, and the quality of life of the patients with breast cancer was enhanced. The discharge preparedness nursing intervention based on the IKAP model is an effective approach, offering a reference for clinical healthcare workers to optimize health education interventions for the discharge of patients with breast cancer, develop targeted discharge plans, and enhance the discharge preparation process.

Appendix

Table 4 The results of multiple imputations for the two-group effects of the total scores and scores of each dimension of discharge readiness, disease uncertainty, and patients'quality of life at each time point (β)

Subtitle	β_0	Before intervention	On discharge day	3 weeks	6 weeks	9 weeks	12 weeks
The total score of caregivers'discharge readiness	18.46(17.42,19.5)	-0.24(-1.73,1.25)	1.49(-0.01,2.99)	3.78(2.05,5.52)	5.13(3.60,6.67)	6.03(4.46,7.60)	7.20(5.48,8.91)
The total score of caregivers'perception of disease uncertainty	84.94(82.41,87.47)	1.08(-2.53,4.69)	-1.77(-5.41,1.87)	-6.12(-10.22,-2.02)	-9.98(-13.77,-6.20)	-13.38(-17.04,-9.72)	-15.88(-19.91,-11.85)
The total score of patients'quality of life	148.18(144.38,151.98)	-1.5(-6.94,3.94)	0.60(-5.12,6.31)	3.76(-1.77,9.28)	9.12(3.32,14.92)	12.48(6.87,18.10)	15.70(10.10,21.31)

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Author contribution Dear Editor: All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by [Li Wang], [Chanfei Lu] and [Jiali Zhong]. The manuscript was written by [Qi Zhang], [Jinfen Li] and [Yuanyuan Liu]. [Mengyao Ji] and [Huan Yi] prepared Figs. 1–2. [Fengxia Huang], [Cheng Huang] and [Yixia Lin] prepared tables 1–3.All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript. Thank you for your consideration. I look forward to hearing from you. Sincerely, Wang Li Department of Oncology, Peking University Shenzhen Hospital No.1120, Lianhua Road, Futian District, Shenzhen, Guangdong, China, PC 518000 8613823535516 0755–83923333 1176265298qq.com.

Data availability No datasets were generated or analysed during the current study.

Declarations

Conflicts of interest The authors declare no competing interests.

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