Zhang *et al. BMC Psychology* (2025) 13:310
https://doi.org/10.1186/s40359-025-02632-0

BMC Psychology

RESEARCH Open Access

Family-centered online positive psychological intervention for breast cancer patients and family caregivers: a single-arm pre-post study of feasibility and preliminary effects

Yao Zhang[1,2], Ruijin Tang[1], Dan Wang[3], Xiaoxu Li[3], Liuna Bi[1], Ming Shi[4] and Jing Han[1*]

Abstract

Background Breast cancer patients and their family caregivers would experience positive changes after diagnosed. We aimed to construct an online positive psychological intervention program for breast cancer patients and their caregivers and evaluate its feasibility and preliminary effects on positive psychological experience and quality of life.

Methods A single-arm pretest and posttest quasi-experimental design was used in this study. Thirty-five dyads of chemotherapeutic breast cancer patients and caregivers were recruited. Four modules of online positive psychological interventions were developed, each lasting 20–30 min. Participants received a 4-week online positive psychological intervention during chemotherapy. Feasibility was assessed, including the rates of enrollment, retention, adherence and acceptability. Resilience, hope, perceived benefit, positive aspects of caregiving, and quality of life were assessed as the preliminary effects of the intervention. 62.5% of recruited individuals participated in the intervention. The mean number of watching modules was 2.8 ± 0.8 for breast cancer patients and 2.6 ± 0.8 for caregivers. 52.2% of patients and 47.8% of caregivers watched three modules in the intervention. For the loving-kindness meditation practice, 34.8% of patients practiced for 15 to 21 days and 52.2% of caregivers practiced for < 7 days. For the three good things practice, 56.5% of patients and 47.8% of caregivers practiced for 7 to 14 days. Mean scores on the acceptable scale for patients and caregivers were 27.61 ± 3.71 and 25.91 ± 3.01, respectively. The results of a linear mixed model showed that the preliminary effects of the intervention on participants' resilience, hope, perceived benefits, positive aspects of caregiving, and quality of life were significant ($p < 0.05$).

Conclusions The online positive psychological interventions for breast cancer patients and family caregivers are feasible, and has significant preliminary effects on participants' resilience, hope, perceived benefits, positive aspects of caregiving, and quality of life, however, the effects warrant further randomized controlled trials.

Trial registration Chinese Clinical Trial Registry (ChiCTR) ChiCTR2300072809. Registered on 26 June 2023Retrospectively registered.

Keywords Positive psychological intervention, Breast cancer, Caregiver, Online, Feasibility

---

*Correspondence:
Jing Han
jingandyang@163.com
[1] Xuzhou Medical University, Xuzhou, China
[2] Xinyi People's Hospital, Xuzhou, China
[3] Affiliated Hospital of Xuzhou Medical University, Xuzhou, China
[4] The First Clinical College of Xuzhou Medical University, Xuzhou, China

Background

Breast cancer is the most commonly diagnosed cancer among females in the world. In China, there are projected to be 429,105 new cases of breast cancer in 2022 [1]. During the period of diagnosis and treatment of the disease, both the patients and families experience psychological and physical distress [2, 3]. Lyu et al. conducted prospective study and found that cancer patients had a 41.7% incidence of psychological distress during chemotherapy [4], and a prospective observational study found that caregivers of cancer patients experienced caregiving burden, with more than 90% of caregivers reporting caregiving burden [5]. The psychological distress experienced by cancer patients and family caregivers can affect their quality of life [6].

Cancer patients and family caregivers would exhibit positive psychological experiences after the cancer diagnosis. Previous cross-sectional studies have found that patients with cancer during chemotherapy experience positive psychological experiences, such as resilience [7], hope [8] and perceived benefit [9]. Meanwhile, family caregivers experienced resilience [10], hope [11] and positive aspects of caregiving [10] when caring cancer patients. Since positive psychology predict a better quality of life for individuals [12], it is important to promote positive psychological experience of breast cancer patients and their caregivers.

Positive psychological interventions involve encouraging individuals to recognize their own positive psychology through positive psychology techniques, and adapt the corresponding positive intervention measures to relieve pain and form positive cognitive emotions and behavior, with the purpose of promoting physical and psychological health and increasing subjective well-being [13]. Previous studies of positive psychological interventions for cancer patients, including gratitude [14], character strengths [15], mindfulness [16], expression of positive emotion writing [17], and other positive psychology techniques, have been found to reduce psychological distress, increase positive psychological experiences, such as hope and positive aspects of caregiving, and improve patients' quality of life.

Meta-analysis suggested that the effect of online intervention was similar to the face-to-face intervention [18]. Randomized controlled studies have found that online psychological interventions can reduce psychological distress [19], enhance psychological resilience, and improve quality of life for cancer patients and caregivers [20]. The use of the internet and mobile phones is very common in China, and the internet penetration rate reaching 71.6% [21], which make it possible to apply online psychological intervention for breast cancer patients and their families.

Literature reviews found that the psychology of cancer patients and their caregivers were mutually influential [22], and that cancer patient-caregiver dyads interventions can improve both the positive psychology of the cancer patients and the caregivers [23]. In Chinese culture, cancer patients caregivers are usually family members, and family members' active participating care is effective in improving patients' outcomes and increasing family's relationship [24, 25]. Few of the studies reported online positive psychological intervention for breast cancer patients and caregivers. Herein, we developed an online positive psychological intervention to enhance the mental health, as well as the quality of life of cancer patients and family caregivers during chemotherapy. This study aimed to test the feasibility and preliminary effects of the intervention.

Methods

Study design

A convenience sampling method was adopted to recruit participants and a single-arm pretest and posttest design was used. Breast cancer patients and family caregivers simultaneously received a 4-week online positive psychological intervention. Data were collected at baseline before intervention (T1), immediately after intervention (T2), and one month after intervention (T3). This study was retrospectively registered with the Chinese Clinical Trial Registry (ChiCTR, registration number: ChiCTR2300072809).

Participants

Participants were recruited at a tertiary hospital with a capacity of 4,150 beds in an eastern coastal city in China, between September 2021 and February 2022. The inclusion criteria for breast cancer patients were as follows: (1) age ≥ 18 years; (2) diagnosed breast cancer, with stage I to III according to TNM; (3) undergoing chemotherapy; (4) knowing disease diagnosis; (5) having basic text reading and language communication skills; (6) having a smartphone and using the We-Chat (an instant messaging service application in China); (7) available to the Internet. The exclusion criteria for patients were: (1) metastatic or recurrent or other malignant tumors; (2) participated in another psychological intervention; (3) having a history of mental illness. The inclusion criteria for family caregivers were (1) age ≥ 18 years; (2) knowing disease diagnosis; (3) having basic text reading and language communication skills; (4) having a smartphone and using the We-Chat; (5) available to the Internet; (6) assuming primary care responsibilities, with no gender restrictions. The exclusion criteria for family caregivers were (1) participated in another psychological intervention; (2) having a history of mental illness.

In this study, G*Power program version 3.1.9.7 was used to calculate the sample size, and a Cohen's d of 0.60 [26], an α of 0.05, and power of 0.80 were used for the calculation [27]. Twenty-four patient-caregiver dyads sample sizes were required. However, more participants were recruited into the study.

The online positive psychological intervention

Development of the intervention

Based on the literature review [17], the theory of positive psychology and the health belief model [28, 29], our research group developed of the framework of the intervention. The health belief model is an individual's perception and belief about events, and adopting healthy and preventive behaviors in response to threatening events. This study used positive psychology techniques to enable participants to perceive their own intrinsic resources after the occurrence of threatening events, guided participants to pay attention to positive things, and improved their susceptibility to positive perception. Meanwhile, the correct cognition of negative emotions was provided to participants to correctly deal with negative emotions, so as to avoid improper cognition caused by neglect of participants' negative emotions. In addition, the addition of health education in each module also helped participants adopt healthy behaviors to treat diseases, and finally, through peer education and strengths perception, the participants were enabled to use their own intrinsic resources correctly to cope with the threatening event. The development process was iterative through the research group' discussion. An interdisciplinary team composed of five experts in the social psychological rehabilitation of cancer, clinical nursing of cancer, psychological counseling, and health education revised the initial intervention program in three rounds. The researchers sent the intervention program to the experts through email, conducted offline interviews, explained the research purpose and reviewed the content, collected the opinions of the experts, and reported and discussed the feedback in the research group meeting for further revision. The revised intervention program was mailed to the experts again until a consensus was reached.

Content of the intervention

We formed the four-module positive psychological intervention program, with each module lasting 20–30 min. The themes of the four modules were as follows: (1) Identify your positive emotions. The core skills were optimism and three good things. (2) Enjoy your positive emotions. The core skills were savoring and sandwich communication. (3) Face your unhappiness. The core skills was recognizing negative emotions. (4) With positive emotions, we move forward together. The core skills were gratitude visit, strengths, and peer education. Health education was arranged in each module. Patients and caregivers interaction and sharing sessions were set up in each module, to achieve the dyadic effects of the intervention (see Additional file 1 for details).

Implementation of the intervention

This intervention was conducted with participants through the platform of We-Chat Official Account (through this platform, users can realize all-round communication and interaction of text, pictures, voice and video). The participants received four modules of positive psychological intervention for 28 days. In the intervention, the participants were asked to write down three good things, and listen to loving-kindness meditation every day as homework. The three good things and loving-kindness meditation last 10–15 min. The intervention content of the four modules was four videos, the specific content of which is presented in Additional file 1. In addition to the online video files, text materials and instructions were provided when the recruited individuals agreed to participate in the study so that they could watch the module and complete the homework. The researchers followed up with the participants after the intervention ended.

Measures

Participants' demographic and clinical characteristics

The demographic and clinical characteristics comprised age, gender, education, employment status, marital status, religious, primary caregiver, disease stage (TNM).

Feasibility outcome measures

Enrollment rate was measured by the number of participants divided by the contacted; retention rate was measured by the number of participants who completed measures at T2 divided by the participants at T1; adherence was described by the mean number of modules completed by participants and the mean number of days in 4-week to complete the homework; acceptability was measured by the acceptability scale developed with reference to previous studies [30]. This scale contained eight items, including willing to recommend to others, continuing to participate, satisfied with this intervention, the need met for participants, intervention is working, intervention is interesting, understand the intervention content, and the intervention objectives are clear, that were scored on a scale from 1 (strongly disagree) to 4 (strongly agree), with a total scores of 8 to 32. Higher scores indicated that the participant was more acceptable to the intervention.

Preliminary outcome measures

The Connor-Davidson Resilience Scale (CD-RISC) was used to assess participants' resilience [31]. This scale comprises three dimensions: tenacity, strength, and optimism. It contains 25 items, which were rated on a 5-point

Likert scale from 0 (never) to 4 (almost always). Higher scores indicate higher levels of resilience. The CD-RISC has high internal consistency (Cronbach's $\alpha = 0.93$). The Chinese version of the CD-RISC used in this study was cross-culturally adjusted by Yu et al., and validated among 560 residents (Cronbach's $\alpha = 0.91$) [32]. In this study, Cronbach's α of CD-RISC was 0.84, and the Cronbach's α of each dimension was ranged from 0.71 to 0.88.

The Herth Hope Index (HHI) was used to assess participants' hope [33]. This scale contains three dimensions: positive attitude toward the present and future, taking positive action, and maintaining close relationships with others. The 12-item scale was rated on a 4-point Likert scale from 1 (strongly disagree) to 4 (strongly agree), with higher scores indicating higher levels of hope. The HHI used in this study was cross-culturally adjusted by Zhao and Wang, and validated in 41 hemodialysis patients (Cronbach's $\alpha = 0.85$) [34]. In this study, Cronbach's α of HHI was 0.74, and the Cronbach's α of each dimension was ranged from 0.78 to 0.81.

The Perceived Benefits of Diagnosis and Treatment of Breast Cancer (PB-DT-BC) was used to assess the positive psychological experience of breast cancer patients during diagnosis and treatment [35]. The 17-item scale was rated on a 5-point Likert scale from 1 (not at all) to 5 (very much), with higher scores indicating more perceived benefit from breast cancer diagnosis and treatment. The scale has high internal consistency (Cronbach's $\alpha = 0.95$). The PB-DT-BC used in this study was cross-culturally adjusted by Wu et al., and validated in 150 breast cancer patients, and had high internal consistency (Cronbach's $\alpha = 0.93$) [36]. In this study, Cronbach's α of PB-DT-BC was 0.73.

The Functional Assessment of Cancer Therapy - Breast (FACT-B) was used to assess the quality of life of breast cancer patients, including their physiological status, social or family situation, emotional state, functional status, and additional attention [37]. The FACT-B includes 36 items, which were scored on a 5-point Likert scale from 0 (not at all) to 4 (very much), with higher scores indicating better quality of life for breast cancer patients. The FACT-B used in this study was cross-culturally adjusted validated in 165 breast cancer patients, and the Cronbach's α coefficient was 0.61 to 0.84 [38]. In this study, Cronbach's α of FACT-B was 0.55, and the Cronbach's α of each dimension was ranged from 0.65 to 0.76.

The Positive Aspects of Caregiving (PAC) was used to assess caregivers' positive feelings, including self-affirmation and life expectancy [39]. The nine-item scale was rated on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree), with higher scores indicating more positive feelings experienced by the caregivers. The PAC used in this study was cross-culturally adjusted by Zhang and Li, and validated in 108 senile dementia caregivers (Cronbach's $\alpha = 0.90$) [40]. In this study, Cronbach's α of PAC was 0.70, and the Cronbach's α of each dimension was ranged from 0.76 to 0.93.

The Caregiver Quality Of Life Scale (CQOL) was used to assess the quality of life of cancer caregivers, including their physical health, mental health, social adaptation, and spiritual health [41]. The scale contains 35 items, and the score of each item ranges from 0 to 10 points. Higher scores indicate better quality of life. The CQOL used in this study was cross-culturally adjusted by Liu et al., and validated in 100 laryngeal cancer patients, and the Cronbach's α coefficient was 0.79 [41]. In this study, Cronbach's α of CQOL was 0.77, and the Cronbach's α of each dimension was ranged from 0.73 to 0.79.

Procedure

To begin with, the research team obtained official authorization from the copyright holders to utilize the Chinese versions of the following instruments: the CD-RISC, HHI, PB-DT-BC, FACT-B, PAC, and CQOL. Recruitment was carried out in the form of advertising, and face-to-face communication. Breast cancer patients undergoing chemotherapy and family caregivers were screened and contacted to ensure they met the eligibility criteria. The recruited individuals were informed of the purpose and content of the study, and informed consent was obtained. Once recruited individuals agreed to participate, the researchers further explained the study. Breast cancer patients and family caregivers who met the eligibility criteria were then invited to participate, and completed measurements at T1, including demographic and clinical characteristics, CD-RISC, HHI, PB-DT-BC, FACT-B, PAC, and CQOL. At T2, participants completed measurements in addition to demographic and clinical characteristics, as well as reported number of watching modules, the completion of homework, the reasons for not completing homework, and open feedback on the intervention. At T3, participants completed the same measurements as T2. The measurements of T1 and T2 were measured face to face, while T3 was measured online through the platform of We-Chat. This study was approved by the Medical Ethics Committee of the Affiliated Hospital of Xuzhou Medical University(XYFY2022-KL051-01). The participants' privacy and anonymity and the data measured before and after the intervention were protected during the study, and the participants could withdraw or terminate their involvement at any time. After the intervention, the participants received gifts as compensation for their participation.

Data analysis

IBM SPSS Statistics 23.0 was used for statistical analysis of the collected data. Descriptive statistics were used to analyze the demographic and clinical characteristics, participation, retention, acceptance, and scores on total scales and sub-scales. Since the data reported by patients and caregivers conform to normal distribution, a linear mixed model (LMM) in SPSS was used to analyze repeated measurements to evaluate the preliminary effects of the intervention. For outcome data reported by patients or caregivers separately, the model included only the main effect of time. For the outcome data reported by both patients and caregivers, a multilevel model was constructed that included the main effect of time and role (patient or caregiver), as well as time×role interactions effects. Three repeated measurements were utilized in this study, the interval between repeated measurements was not too long, and the sample size was small, meaning that compound symmetry was considered in the repeated covariance types. The information criteria in the model were the standard selection model. The effects of the intervention were reflected by a significant main effect of time. The interaction of time×role was used to indicate whether the intervention had different effects on patients and caregivers over time. During the follow-up, there was no significant difference between the baseline data of the falling off and the retention (all $p > 0.05$). A level of $p < 0.05$ was considered statistically significant.

Table 1 Breast cancer patient and caregiver demographic and clinical characteristics at baseline (*n* = 23 dyads)

Characteristics	Patients *n*(%)	Caregivers *n*(%)
Gender		
Female	23(100.0)	5 (21.7)
Male	-	18 (78.3)
Education		
Junior middle school or below	8 (43.5)	7 (30.4)
Senior middle school	9 (39.1)	6 (26.1)
University or above	4 (17.4)	10 (43.5)
Employment status		
Yes	3 (13.0)	11 (47.8)
No	20 (87.0)	12 (52.2)
Marital status		
Unmarried/Divorced	2 (8.7)	1 (4.3)
Married	21 (91.3)	22 (95.7)
Religion		
No	20 (87.0)	22 (95.7)
Yes	3 (13.0)	1 (4.3)
Primary caregiver		
Partner	17 (73.9)	
Children	4 (17.4)	
Parents	1 (4.3)	
Nursing workers	1 (4.3)	
Disease stage (TNM)		
I	10 (43.5)	
II	7 (30.4)	
III	6 (16.1)	

Results

Participant characteristics

Table 1 shows the demographic and clinical characteristics of the patients and caregivers. The average age of the patients was 48 years old (SD = 7.68; range: 26–64), most of them had graduated from senior middle school (39.1%), 91.3% were married, and their main caregivers were their partners (73.9%). The disease stages were mostly stage I (43.5%). The mean age of the caregivers was 46 (SD = 9.66; range: 27–64), 78.3% were male, 30.4% had graduated from junior middle school or below, and most of them were married (95.7%).

Feasibility outcomes

Enrollment and retention

As showed in Figs. 1 and 85 dyads of breast cancer patients and caregivers were screened, excluding those with metastatic cancer (*n* = 12 dyads), treatment was almost over (*n* = 9 dyads), unable to use a smartphone (*n* = 3 dyads), and without caregivers (*n* = 5 dyads). Fifty-six dyads were contacted, and 35 dyads were enrolled for the intervention. The main reasons for not attending included lacking of interest in the intervention (*n* = 11 dyads), unable to participate due to medical reasons (*n* = 7 dyads), disapproval from caregivers (*n* = 1 dyads), and reluctance to discuss the topic of disease (*n* = 2 dyads). Overall, the enrollment rate was approximately 62.5%. Data from participants who did not watch the intervention modules were excluded. The retention of participants was acceptable with 85.7% (30/35) of patients and 71.4% (25/35) of caregivers completed the post-intervention measurements. The final analysis used data from 23 dyads of participants.

Adherence and acceptability

The mean number of watching modules was 2.8 ± 0.8 for breast cancer patients and 2.6 ± 0.8 for caregivers. 52.2% of patients and 47.8% of caregivers watched 3 modules. For the loving-kindness meditation practice, the mean time of practice was 13.7 ± 7.0 days for breast cancer patients and 8.8 ± 6.0 days for caregivers. 34.8% of patients practiced for 15 to 21 days and 52.2% of caregivers practiced for < 7 days. For the three good things practice, the mean time of practice was 14.3 ± 4.9 days for breast cancer patients and 10.6 ± 5.4 days for caregivers. 56.5% of patients and 47.8% of caregivers practiced for 7 to 14 days (see Table 2). The main reasons for participants' failure to complete the module watching and homework were forgetting homework, side effects caused by chemotherapy during the intervention, and caregivers being busy with work and taking care of the patients.

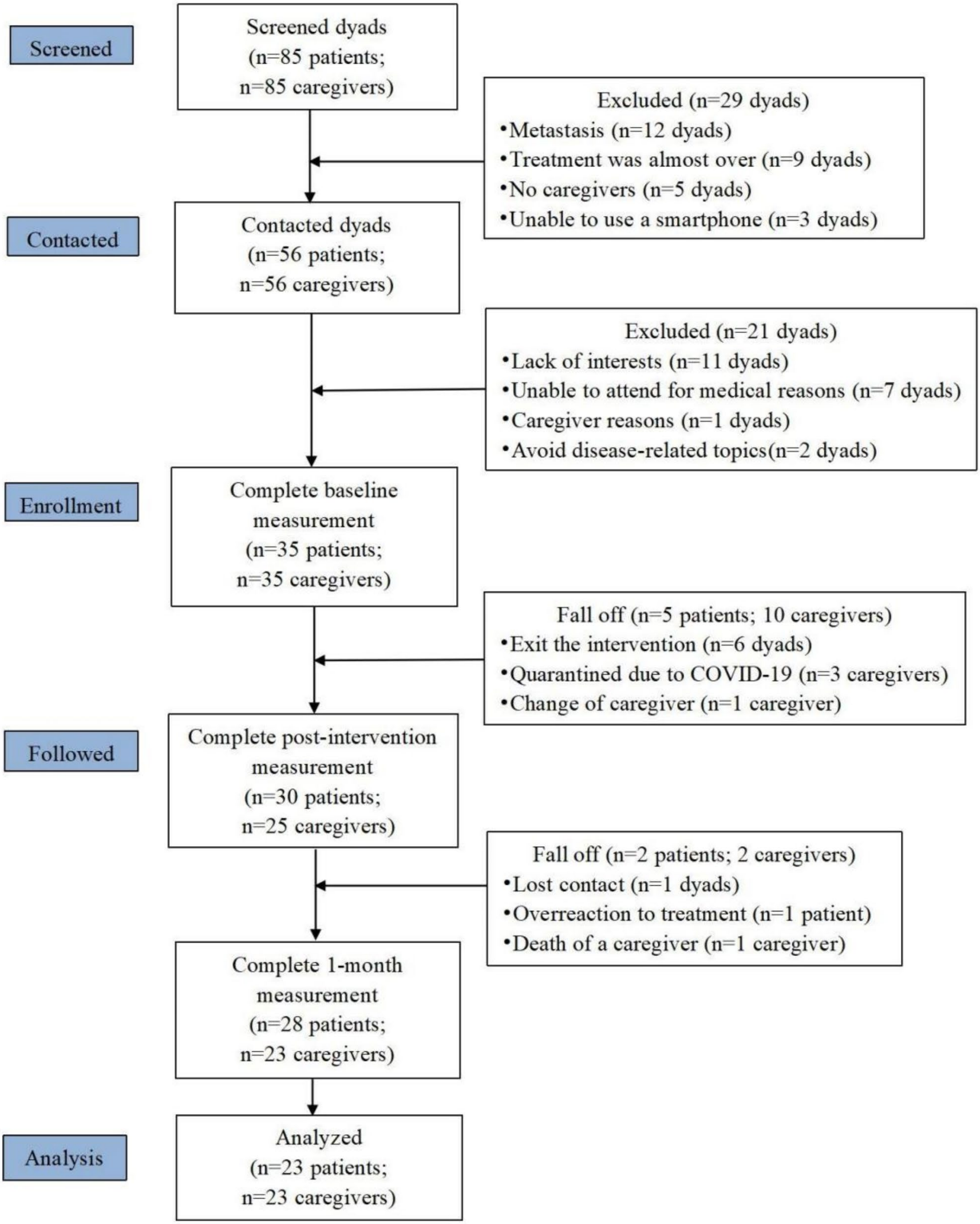

Fig. 1 Recruitment flowchart

Table 2 Adherence condition of participants to watch module and complete homework ($n = 23$ dyads)

Variables	Patients (*n*, %)	Caregivers (*n*, %)
The number of module watched		
1	1 (4.3)	2 (8.7)
2	6 (26.1)	8 (34.8)
3	12 (52.2)	11 (47.8)
4	4 (17.4)	2 (8.7)
The number weeks of loving-kindness meditation completed		
<7 days	6 (26.1)	12 (52.2)
7–14 days	4 (17.4)	7 (30.4)
15-21days	8 (34.8)	2 (8.7)
22–28 days	5 (21.7)	2 (8.7)
The number of three good things completed		
<7 days	-	5 (21.7)
7–14 days	13 (56.5)	11 (47.8)
15-21days	6 (26.1)	6 (26.1)
22–28 days	4 (17.4)	1 (4.3)

Figures 2a and b showed the acceptability of interventions reported by patients and caregivers, respectively.

Feedback from participants

Both patients and caregivers gave positive feedback about the homework, including the relaxing effect of the loving-kindness meditation and an increase in their mood when they focused on writing about three good things instead of thinking about other bad things. For patients, strengths are considered to be effective, used to identify their own outstanding characteristics in the face of threatening events, and increase their confidence. For caregivers, trying sandwich communication in daily conversations was effective and improved their positive feelings during caregiving. However, caregivers also expressed the burden of the intervention, such as the daily workload of homework. The mean score of the patient acceptability scale was 27.61 ± 3.71, as well as the mean score of 25.91 ± 3.01 for caregiver. Most participants chose "agree" or "strongly agree," showing high acceptability of the intervention.

Preliminary outcomes

The results of the linear mixed model analysis are presented in Tables 3 and 4. In terms of the results from the dyad analysis, time had a significant effect on the CD-RISC total score and dimensions of tenacity, strength, optimism, as well as on the HHI total score and dimensions of positive attitude toward the present and future, taking positive action, maintaining close relationships with others (all $p < 0.05$). As shown by the means presented in Table 3, these outcomes improved in both patients and caregivers over time (except that the means decreased from T2 to T3 in the patients' total CD-RISC score, optimism, and positive attitude towards present and future). The effects of the interventions on patients and caregivers differed in these areas over time. There was a significant effect of role on optimism, HHI scores, positive attitude towards present and future, and maintaining close relationships with others; for example, patients showed higher levels of optimism than caregivers (all $p < 0.05$). In addition, multiple models showed that there were interactions of time×role in HHI score, positive attitude towards present and future, and maintaining close relationships with others (all $p < 0.05$).

For individuals (see Table 4), time was significant in patients' PB-DT-BC, FACT-B, and additional attention scores (all $p < 0.05$), but there were decreases between T2 and T3 in FACT-B scores. Time had a significant effect on caregivers' PAC scores, self-affirmation, CQOL scores, mental health, and spiritual health (all $p < 0.05$). However, there was no significant effect of time on patients' physiological status, social or family situation, emotional state, functional status, and additional attention or caregivers' life expectancy, physical health, and social adaptation (all $p > 0.05$).

Discussion

This study constructed a 4-week online positive psychological intervention for breast cancer patients and tested its feasibility and preliminary effects, providing evidence for the use of online positive psychological interventions in breast cancer patients and their caregivers.

During the recruitment, 62.5% of individuals agreed to participate in this study, which is consistent with a previous meta-analysis report [42]. Early diagnosis of cancer might have made participants willing to participate in psychological support. The majority of cancer patients in the cancer treatment are unemployed [43], and sufficient time help them to participate, thus transfer their attention to the disease and treatment, and reduce the caregiver's psychological care burden, consistent with the open feedback of participants. It also verified the need for breast cancer patients and caregivers to seek psychological support, and the importance of positive psychological intervention during chemotherapy [44]. We used strategies to promote retention rate, such as sending daily intervention content via We-Chat and giving gifts to participants after follow-up, and results of this study also showed the good retention rate for participants.

We observed that the adherence of patients were higher than that of caregivers in this study. A meta-analysis of online psychological interventions showed that women had higher adherence than men [45]. Additionally, Beatty et al. showed that women were more likely than men to actively seek psychological help [46]. These might be the reasons why patients' adherence was higher than caregivers'. Meanwhile, 73.9% of caregivers were partners

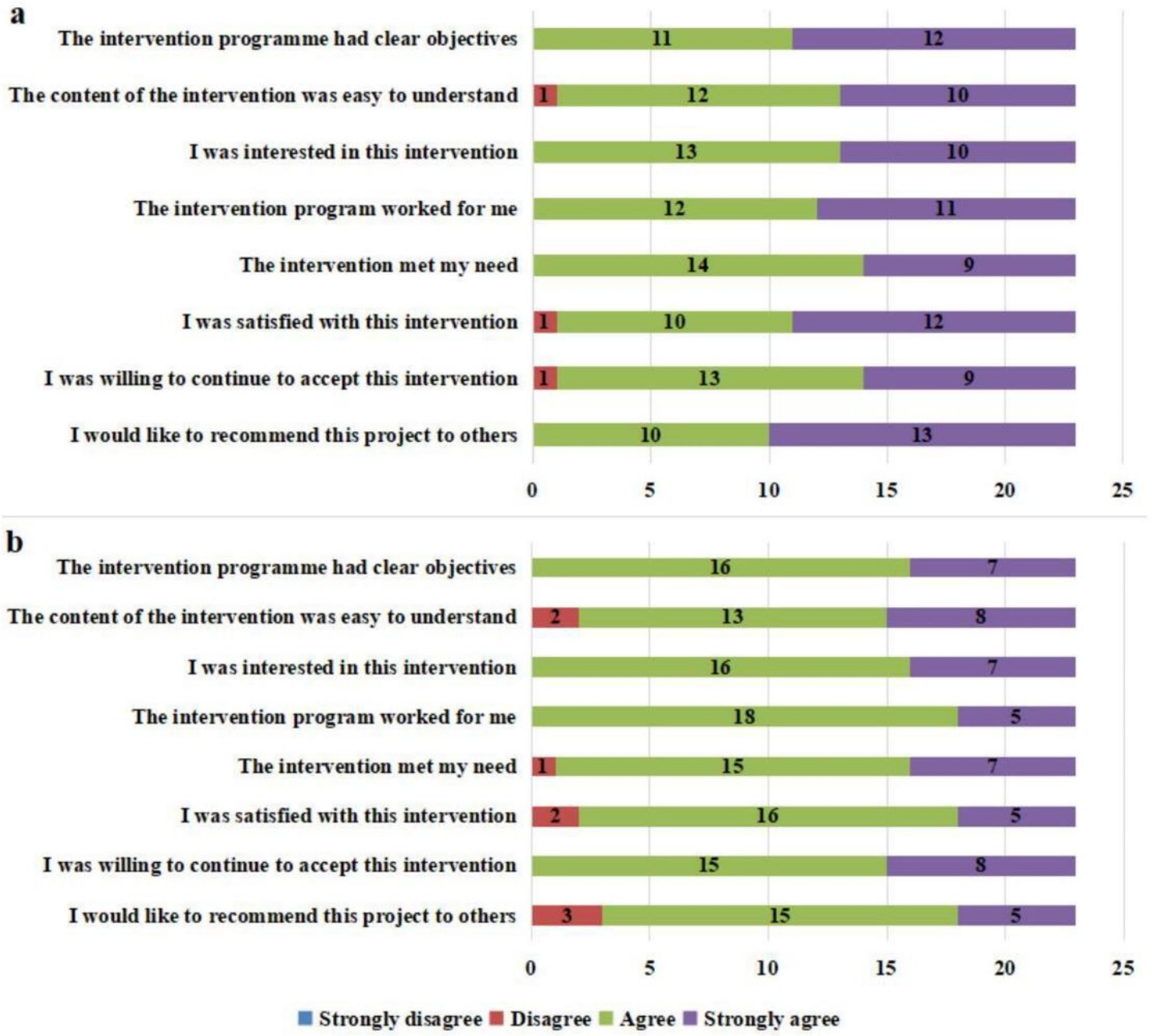

Fig. 2 Acceptability of interventions for breast cancer patients and caregivers ($n = 23$ dyads)

in this study, and were at work simultaneously, so their time was divided, which was also an important reason why they could not adhere to completing the intervention, which was consistent with the open feedback. The proper arrangement of the caregiver's homework needed to be considered. Although the participation rate of participants was not high, their acceptability of this intervention was positive, and most participants agreed or strongly agreed with the intervention, which also provides evidence that the intervention was acceptable for patients and their caregivers.

The intervention showed significant results in enhancing the positive psychological experiences of patients and caregivers. Following the intervention, levels of resilience and hope improved significantly for both patients and caregivers. Indeed, previous studies have shown that giving cancer patients or caregivers positive psychological interventions significantly improves resilience and hope [14, 47, 48]. However, parts of the CD-RISC and HHI scores declined from T1 to T2 and T2 to T3 after the intervention, possibly due to the mood swings caused by chemotherapy side effects [49] and follow-up effects. Caregivers, by contrast, benefited more consistently and significantly from the intervention. This was supported by the open feedback from our participants and consisted with the research of Beatty et al. [46]. Levels of PB-DT-BC and PAC scores were significantly improved. Studies have shown that resilience may significantly predict positive perceived benefits, which might be one of the reasons why perceived benefits changed significantly after

Table 3 Preliminary effects of the intervention ($n = 23$ dyads)

	Mean (SD)						**F**	***P***
Outcomes fixed effect	**Survivor**			**Caregiver**				
	T1	**T2**	**T3**	**T1**	**T2**	**T3**		
CD-RISC	60.87 (13.76)	69.00 (17.20)	64.65 (9.05)	57.48 (14.70)	67.83 (16.55)	76.35 (18.09)		
Time							19.65	< 0.001
Role							1.33	0.251
Time×Role							1.61	0.207
Tenacity	32.09 (8.21)	35.04 (9.58)	36.78 (9.40)	30.65 (7.83)	35.87 (9.27)	40.39 (9.56)		
Time							15.45	< 0.001
Role							1.04	0.310
Time×Role							1.89	0.172
Strength	18.96 (4.40)	21.91 (5.41)	22.65 (5.16)	19.00 (4.86)	22.00 (5.52)	24.00 (6.16)		
Time							16.20	< 0.001
Role							0.12	0.728
Time×Role							0.37	0.547
Optimism	9.83 (2.39)	12.04 (2.98)	11.91 (3.04)	7.83 (3.19)	9.96 (3.022)	11.96 (3.39)		
Time							25.09	< 0.001
Role							6.40	0.013
Time×Role							2.71	0.102
HHI	37.30 (3.21)	34.52 (3.36)	38.04 (3.59)	34.44 (2.68)	37.39 (3.22)	40.65 (3.19)		
Time							25.29	< 0.001
Role							9.51	0.002
Time×Role							15.68	< 0.001
Positive attitude towards present and future	12.09 (1.28)	12.30 (1.52)	12.09 (1.20)	10.87 (1.10)	12.17 (1.03)	13.35 (0.98)		
Time							25.59	< 0.001
Role							22.45	< 0.001
Time×Role							25.59	< 0.001
Take positive action	13.39 (1.41)	10.04 (1.22)	13.57 (1.50)	12.44 (1.20)	13.35 (1.53)	13.83 (1.53)		
Time							4.40	0.038
Role							0.19	0.667
Time×Role							2.66	0.105
Maintain close relationships with others	11.83 (1.15)	12.17 (1.23)	12.39 (1.41)	11.13 (1.01)	11.87 (1.10)	13.48 (1.24)		
Time							35.07	< 0.001
Role							10.89	< 0.001
Time×Role							13.13	< 0.001

SD standard deviation; df degree of freedom; CD-RISC, Connor-Davidson Resilience Scale; HHI, Herth Hope Index.

receiving this intervention [50]. Fan et al. highlighted that participants could improve their positive cognitive abilities and mobilize their own strength to deal with the disease by being supported to accept and pay attention to the present [51]. This was consisted with the open feedback from caregivers. Another reason might be that the psychological states of the patients and caregivers mutually influenced each other [22]. The dyadic intervention program provided to patients and caregivers might be the reason for the improvement in preliminary effects. In this study, positive introduction to others helped patients and caregivers to explore mutual strengths, guided them to perceive the potential strength of themselves and supporters when faced with threatening events, exert family support, and promote positive psychological experience of patients and caregivers. Similarly, patients and caregivers practiced the sandwich communication method with each other during the intervention, through the training of communication skills to improve the way of

Table 4 Preliminary effects of the intervention separately (*n* = 23 survivors; *n* = 23 caregivers)

Outcomes	Mean(SD)						F	*P*
	Survivor			**Caregiver**				
	T1	**T2**	**T3**	**T1**	**T2**	**T3**		
PB-DT-BC	53.44 (7.80)	60.13 (11.60)	64.65 (9.05)				16.32	< 0.001
FACT-B	58.35 (14.22)	69.87 (15.86)	67.39 (15.23)				4.10	0.047
physiological status	8.78 (5.36)	11.17 (6.41)	8.96 (5.25)				0.01	0.918
Social/family situation	16.30 (3.97)	19.26 (4.61)	18.04 (5.98)				1.44	0.234
Emotional state	4.39 (3.84)	6.96 (3.96)	6.30 (3.66)				2.90	0.093
Functional status	17.65 (5.74)	17.44 (4.43)	18.09 (4.36)				0.10	0.759
Additional attention	11.22 (5.39)	15.04 (6.40)	16.00 (6.74)				7.06	0.010
PAC				32.87 (5.97)	36.39 (6.49)	37.00 (7.83)	4.38	0.040
Self-affirmation				16.70 (4.27)	20.09 (4.21)	20.30 (4.98)	7.52	0.008
Life expectancy				16.17 (2.53)	16.30 (3.35)	16.70 (3.23)	0.35	0.556
CQOL				194.52 (58.49)	202.39 (51.38)	232.96 (55.79)	5.75	0.019
physical health				55.17 (14.01)	50.52 (13.79)	56.83 (15.73)	0.15	0.699
Mental health				34.91 (23.84)	41.35 (21.19)	51.04 (23.77)	5.93	0.018
Social adaptation				53.48 (21.07)	54.78 (18.92)	64.09 (16.82)	3.70	0.058
Spiritual health				50.96 (15.45)	55.74 (14.28)	61.00 (13.46)	5.83	0.018

Time enters the fixed effect as the main effect; df degree of freedom, SD standard deviation.

PB-DT-BC, Perceived Benefits of Diagnosis and Treatment of Breast Cancer; FACT-B, Functional Assessment of Cancer Therapy - Breast; PAC, Positive Aspects of Caregiving; CQOL, Caregiver Quality Of Life Scale.

communication between patients and caregivers, promote mutual understanding, and enhance their positive feelings.

Unfortunately, parts of the participants' quality of life did not significantly improve. This study was conducted during chemotherapy, which caused side effects that might have affected our results. Meanwhile, only four patients (17.4%) and two caregivers (8.7%) who watched all the modules, and fewer patients and caregivers who completed homework for ≥ 3 weeks. This might limited the effect of our intervention, as previous studies has found that higher compliance is associated with higher motivation and quality of life [52]. Although this study arranged corresponding health education knowledge in each module, this was not enough and not sufficiently individualized based on the results and open feedback, and the online application of the intervention might restrict the benefits of participants getting together with others, thus face-to-face group-based intervention should be considered for future research.

There were still some limitations that were worth mentioning. Firstly, the sample size included in this study was small and most of the caregivers were partners, it was not known whether caregivers have different effects of the intervention based on their different roles. The characteristics of family caregivers affected the subject's positive psychological responses has not been explored, which was also considered to be explored in the future study with a large sample size. Secondly, we did not measure the negative emotion on participants. Previous studies have shown that psychological interventions can decrease negative emotion in cancer patients, such as anxiety and depression [53], and negative emotion has positive effects on cancer patients' quality of life [54, 55]. A baseline distress screening measure to assess particularly for anxiety and depression should be considered for application in future studies. Thirdly, in the intervention, we only made participants recognize negative emotions without expressing and ignored the positive effects of negative emotion expression. Therefore, a design culturally appropriate education for the negative emotion expression should be applied in the next research. Fourthly, although the preliminary intervention results of this study also showed positive effects, but we did not measure the effect between groups, and the intervention effect needs to be tested in the future with larger sample sizes and randomized controlled trials.

Conclusion

This study constructed a positive psychological intervention program for breast cancer patients and caregivers. Through the feasibility study, we found the online positive psychological intervention was feasibility among breast cancer and their caregivers, and had preliminary effects on participants' resilience, hope, perceived benefits, positive aspects of caregiving, and quality of life. An advantage of this study was the use of the online psychological intervention. It is necessary to implement online positive psychological intervention, which can be considered as psychological care during adjuvant therapy for breast cancer patients and their caregivers. The validation of the intervention could represent the next step in randomized controlled trials. Although the intervention had no effect on participants' physical health and social adjustment, this provides a direction for improving the intervention program.

Abbreviations

CD-RISC	Connor-Davidson Resilience Scale
HHI	Herth Hope Index
PB-DT-BC	Perceived Benefits of Diagnosis and Treatment of Breast Cancer
FACT-B	The Functional Assessment of Cancer Therapy - Breast
PAC	Positive Aspects of Caregiving
CQOL	Caregiver Quality Of Life Scale
LMM	Linear mixed model

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s40359-025-02632-0.

Additional file 1. Family-centred positive psychological intervention programme.

Acknowledgements

The authors thank the participants for the study support.

Author contributions

JH and MS contributed to study design, the supervision of the intervention process and the revision of the manuscript, and agreed to be responsible for all aspects of the work. DW and XL contributed to the coordination of participants' participation in the study and the collection of data. YZ contributed to data analysis and completed the drafting of the manuscript. RT and LB contributed to the data analysis and implementation of the intervention. All authors have read and approved the manuscript.

Funding

This study was funded by the Major Project of Philosophy and Social science research in Jiangsu Universities (2020SJZDA126).

Data availability

The datasets are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This research involved human participants and all methods were performed in accordance with the relevant guidelines and regulations. The study was approved by the Medical Ethics Committee of the Affiliated Hospital of Xuzhou Medical University(XYFY2022-KL051-01) and retrospectively registered with the Chinese Clinical Trial Registry (ChiCTR2300072809). Written informed consent was obtained from all participants prior to enrollment.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 23 February 2023 / Accepted: 20 March 2025

References

1. Xia C, Dong X, Li H, Cao M, Sun D, He S, Yang F, Yan X, Zhang S, Li N, Chen W. Cancer statistics in China and united States, 2022: profiles, trends, and determinants. Chin Med J. 2022;135(5):584–90. https://doi.org/10.1097/CM9.0000000000002108.
2. Carreira H, Williams R, Müller M, Harewood R, Stanway S, Bhaskaran K. Associations between breast cancer survivorship and adverse mental health outcomes: A systematic review. J Natl Cancer Inst. 2018;110(12):1311–27. https://doi.org/10.1093/jnci/djy177.
3. Li Q, Lin Y, Xu Y, Zhou H. The impact of depression and anxiety on quality of life in Chinese cancer patient-family caregiver dyads, a cross-sectional study. Health Qual Life Outcomes. 2018;16(1):230. https://doi.org/10.1186/s12955-018-1051-3.
4. Lyu D, Lan B, Sun XY, Yang M, Zhang L, Ma F. [Relationship between dynamic changes of psychological distress and quality of life in Chinese early breast cancer patients]. Zhonghua Zhong Liu Za Zhi. 2022;44(10):1119–24. https://doi.org/10.3760/cma.j.cn112152-20210412-00308.
5. Mishra S, Gulia A, Satapathy S, Gogia A, Sharma A, Bhatnagar S. Caregiver burden and quality of life among family caregivers of cancer patients on chemotherapy: A prospective observational study. Indian J Palliat Care. 2021;27(1):109–12. https://doi.org/10.4103/IJPC.IJPC_180_20.
6. Gan GG, Tey KWF, Mat S, Saad M, Bee PC, Abdul Malik R, Ho GF, Ng CG. Quality of life of family caregivers of cancer patients in a developing Nation. Asian Pac J Cancer Prev. 2022;23(11):3905–14. https://doi.org/10.31557/APJCP.2022.23.11.3905.
7. Ruiz-Rodríguez I, Hombrados-Mendieta I, Melguizo-Garín A, Martos-Méndez MJ. The importance of social support, optimism and resilience on the quality of life of cancer patients. Front Psychol. 2022;13:833176. https://doi.org/10.3389/fpsyg.2022.833176.
8. Li Y, Zhou Z, Ni N, Li J, Luan Z, Peng X. Quality of life and hope of women in China receiving chemotherapy for breast cancer. Clin Nurs Res. 2022;31(6):1042–9. https://doi.org/10.1177/10547738211046737.
9. Wan X, Wang X, Li Y, Zhang Y. Correlations of perceived benefit and psychological distress in patients with breast cancer after adjuvant chemotherapy. Mod Clin Nurs. 2019;18(7):1–5. https://doi.org/10.3969/j.issn.1671-8283.2019.07.001.
10. Palacio C, Krikorian A, Limonero JT. The influence of psychological factors on the burden of caregivers of patients with advanced cancer: resiliency and caregiver burden. Palliat Support Care. 2018;16(3):269–77. https://doi.org/10.1017/S1478951517000268.
11. Cao N, LI H, Zhao Y. Study on influencing factors of level of hope in caregivers for patients with esophageal cancer. Tianjin J Nurs. 2021;29(1):9–13. https://doi.org/10.3969/j.issn.1006-9143.2021.01.003.
12. Edward KL, Chipman M, Giandinoto JA, Robinson K. Quality of life and personal resilience in the first two years after breast cancer diagnosis: systematic

integrative review. Br J Nurs. 2019;28(10):S4–14. https://doi.org/10.12968/bjon.2019.28.10.S4.

13. Seligman ME, Steen TA, Park N, Peterson C. Positive psychology progress: empirical validation of interventions. Am Psychol. 2005;60(5):410–21. https://doi.org/10.1037/0003-066X.60.5.410.
14. Tu M, Wang F, Shen S, Wang H, Feng J. Influences of psychological intervention on negative emotion, cancer-Related fatigue and level of hope in lung cancer chemotherapy patients based on the PERMA framework. Iran J Public Health. 2021;50(4):728–36. https://doi.org/10.18502/ijph.v50i4.5997.
15. Li M, Sun H, Shao Y. Effects of character Strengths-Based intervention on subjective Well-being, anxiety and depression among breast cancer patients undergoing chemotherapy. Nurs J Chin PLA. 2018;35(9):1–6. https://doi.org/10.3969/j.issn.2018.09.001
16. Geng L, Wang J, Cheng L, Zhang B, Shen H. Mindful learning improves positive feelings of cancer patients' family caregivers. Int J Environ Res Public Health. 2019;16(2):248. https://doi.org/10.3390/ijerph16020248.
17. Casellas-Grau A, Font A, Vives J. Positive psychology interventions in breast cancer. A systematic review. Psychooncology. 2014;23(1):9–19. https://doi.org/10.1002/pon.3353.
18. Wan SW, Chng YJD, Lim SH, Chong CS, Pikkarainen M, He HG. A systematic review and meta-analysis on the effectiveness of web-based psychosocial interventions among patients with colorectal cancer. J Adv Nurs. 2022;78(7):1883–96. https://doi.org/10.1111/jan.15258.
19. Fergus K, Ahmad S, Gardner S, Ianakieva I, McLeod D, Stephen J, Carter W, Periera A, Warner E, Panchaud J. Couplelinks online intervention for young couples facing breast cancer: A randomised controlled trial. Psychooncology. 2022;31(3):512–20. https://doi.org/10.1002/pon.5836.
20. Peng L, Yang Y, Chen M, Xu C, Chen Y, Liu R, Cao X, Li M. Effects of an online mindfulness-based intervention on fear of cancer recurrence and quality of life among Chinese breast cancer survivors. Complement Ther Clin Pract. 2022;49:101686. https://doi.org/10.1016/j.ctcp.2022.101686.
21. The 48th Statistical Report on China's Internet Development. China Internet Network Information Center(CNNIC). http://www.cnnic.net.cn/hlwfzyj/hlwxzbg/hlwtjbg/202109/t20210915_71543.htm
22. Li Q, Loke AY. A literature review on the mutual impact of the spousal caregiver-cancer patients dyads: 'communication', 'reciprocal influence', and 'caregiver-patient congruence'. Eur J Oncol Nurs. 2014;18(1):58–65. https://doi.org/10.1016/j.ejon.2013.09.003.
23. Otto AK, Ketcher D, Reblin M, Terrill AL. Positive psychology approaches to interventions for cancer dyads: A scoping review. Int J Environ Res Public Health. 2022;19(20):13561. https://doi.org/10.3390/ijerph192013561.
24. Zhang Y, Zhang S, Liu C, et al. Caregiver burden among family caregivers of patients with advanced cancer in a palliative context: A mixed-method study. J CLIN NURS. 2023. https://doi.org/10.1111/jocn.16872. 32 J CLIN NURS.
25. Mardanpour M, Rezaei J, Vaisi Raygani AA, Abdi A, Salari N, Khaledi-Paveh B, Mohammadi MM. The effect of Family-Centered and Peer-Centered education on the sleep quality of Hemodialysis patients: A randomized clinical trial. SAGE Open Nurs. 2023;9:23779608231178614. https://doi.org/10.1177/23779608231178614.
26. Zhang J, Chen L, Wu Z, Liu X, Li H, Kong D, Zhang Q. The effect of psychological intervention on level of hope and quality of life in the breast cancer patients. Chin J Behav Med Brain Sci. 2010;19(4):341–3. https://doi.org/10.3760/cma.j.issn.1674-6554.2010.04.017.
27. Şengün İnan F, Üstün B. Home-Based psychoeducational intervention for breast cancer survivors. Cancer Nurs. 2018;41(3):238–47. https://doi.org/10.1097/NCC.0000000000000483.
28. Seligman ME, Csikszentmihalyi M. Positive psychology. An introduction. Am Psychol. 2000;55(1):5–14. https://doi.org/10.1037//0003-066x.55.1.5.
29. Jones CL, Jensen JD, Scherr CL, Brown NR, Christy K, Weaver J. The health belief model as an explanatory framework in communication research: exploring parallel, serial, and moderated mediation. Health Commun. 2015;30(6):566–76. https://doi.org/10.1080/10410236.2013.873363.
30. Weiner BJ, Lewis CC, Stanick C, Powell BJ, Dorsey CN, Clary AS, Boynton MH, Halko H. Psychometric assessment of three newly developed implementation outcome measures. Implement Sci. 2017;12(1):108. https://doi.org/10.1186/s13012-017-0635-3.
31. Connor KM, Davidson JR. Development of a new resilience scale: the Connor-Davidson resilience scale (CD-RISC). Depress Anxiety. 2003;18(2):76–82. https://doi.org/10.1002/da.10113.
32. Yu X, Zhang J, Yu XN, Yu XN, Zhang JX. Factor analysis and psychometric evaluation of the connor-davidson resilience scale (cd-risc) with Chinese people. Social Behav Personality: Int J. 2007;35(1):19–30.
33. Herth K. Development and refinement of an instrument to measure hope. Sch Inq Nurs Pract. 1991;5(1):39–56.
34. Zhao H, Wang C. Social support and hope for Hemodialysis patients. Chin J Nurs. 2000;35(5):306–8.
35. Antoni MH, Lehman JM, Kilbourn KM, Boyers AE, Culver JL, Alferi SM, Yount SE, McGregor BA, Arena PL, Harris SD, Price AA, Carver CS. Cognitive-behavioral stress management intervention decreases the prevalence of depression and enhances benefit finding among women under treatment for early-stage breast cancer. Health Psychol. 2001;20(1):20–32. https://doi.org/10.1037//0278-6133.20.1.20.
36. Wu C, Cui Y, Dong J, Wang X. Reliability and validity of the Chinese version of the breast cancer perceived benefit assessment scale. Chin J Nurs. 2015;50(11):1400–3. https://doi.org/10.3761/j.issn.0254-1769.2015.11.026.
37. Cella DF, Tulsky DS, Gray G, Sarafian B, Linn E, Bonomi A, Silberman M, Yellen SB, Winicour P, Brannon J. The functional assessment of cancer therapy scale: development and validation of the general measure. J Clin Oncol. 1993;11(3):570–9. https://doi.org/10.1200/JCO.1993.11.3.570.
38. Wan C, Zhang D, Tang X, Zhang W, Li W, Ren H, He R, Wang W. Introduction of Fact-B Chinese version of quality of life measurement scale for breast cancer patients. Chin MENTAL HEALTH J. 2003;17(5):298–300. https://doi.org/10.3321/j.issn:1000-6729.2003.05.003.
39. Tarlow BJ, Wisniewski SR, Belle SH, Rubert M, Ory MG, Gallagher-Thompson D. Positive aspects of caregiving: contributions of the REACH project to the development of new measures for Alzheimer's caregiving. Res Aging. 2004;26(4):429–53.
40. Zhang R, Li Z. Reliability and validity of the Chinese version of the caregiver positive feeling scale. Chin J Nurs. 2007;42(12):1068–71.
41. Liu Y, Gan X, Tang W, Li X. Application of QOL Scale-Amily in quality of life evaluation of caregivers of patients with laryngeal cancer. Chin Gen Pract. 2009;12(09):726–8.
42. Brebach R, Sharpe L, Costa DS, Rhodes P, Butow P. Psychological intervention targeting distress for cancer patients: a meta-analytic study investigating uptake and adherence. Psychooncology. 2016;25(8):882–90. https://doi.org/10.1002/pon.4099.
43. Cai T, Zhou T, Yuan C, Yu C, Ni F, Sheng Z. Heterogeneity of symptoms and functions among women receiving chemotherapy for breast cancer in China: A multicentre, cross-sectional study. Front Public Health. 2022;10:952710. https://doi.org/10.3389/fpubh.2022.952710.
44. Guglielmucci F, Franzoi IG, Bonafede M, Borgogno FV, Grosso F, Granieri A. The less I think about it, the better I feel: A thematic analysis of the subjective experience of malignant mesothelioma patients and their caregivers. Front Psychol. 2018;9:205. https://doi.org/10.3389/fpsyg.2018.00205.
45. Beatty L, Binnion C. A systematic review of predictors of, and reasons for, adherence to online psychological interventions. Int J Behav Med. 2016;23(6):776–94. https://doi.org/10.1007/s12529-016-9556-9.
46. Beatty L, Kemp E, Turner J, Butow P, Milne D, Yates P, Lambert S, Wootten A, Koczwara B. Moderators of intervention efficacy for finding my way: A web-based psychosocial intervention for cancer-related distress. Support Care Cancer. 2021;29(12):7669–78. https://doi.org/10.1007/s00520-021-06291-w.
47. Köhle N, Drossaert CHC, Ten Klooster PM, Schreurs KMG, Hagedoorn M, Van Uden-Kraan CF, Verdonck-de Leeuw IM, Bohlmeijer ET. Web-based self-help intervention for partners of cancer patients based on acceptance and commitment therapy and self-compassion training: a randomized controlled trial with automated versus personal feedback. Support Care Cancer. 2021;29(9):5115–25. https://doi.org/10.1007/s00520-021-06051-w.
48. Jiang X, Yang Y, Li H, Li S, Su D, Zhang T, Zhang M. An intervention based on protective factors to improve resilience for breast cancer patients: study protocol for a randomized controlled trial. J Adv Nurs. 2019;75(11):3088–96. https://doi.org/10.1111/jan.14108.
49. Shih YW, Su JY, Kung YS, Lin YH, To Anh DT, Ridwan ES, Tsai HT. Effectiveness of acupuncture in relieving Chemotherapy-induced leukopenia in patients with breast cancer: A systematic review with A Meta-Analysis and trial sequential analysis. Integr Cancer Ther. 2021;20:15347354211063884. https://doi.org/10.1177/15347354211063884.
50. Tu PC, Yeh DC, Hsieh HC. Positive psychological changes after breast cancer diagnosis and treatment: the role of trait resilience and coping styles. J Psychosoc Oncol. 2020;38(2):156–70. https://doi.org/10.1080/07347332.2019.1649337.
51. Fan YP, Zhou Z, Ding YT. Interventions of acceptance and commitment in postoperative patients with breast cancer. Nurs J Chin PLA. 2018;35(24):20–3. https://doi.org/10.3969/j.issn.1008-9993.2018.24.005.

52. Cillessen L, van de Ven MO, Compen FR, Bisseling EM, van der Lee ML, Speckens AE. Predictors and effects of usage of an online mindfulness intervention for distressed cancer patients: usability study. J Med Internet Res. 2020;22(10):e17526. https://doi.org/10.2196/17526.
53. Chang YC, Yeh TL, Chang YM, Hu WY. Short-term effects of randomized Mindfulness-Based intervention in female breast cancer survivors: A systematic review and Meta-analysis. Cancer Nurs. 2021;44(6):E703–14. https://doi.org/10.1097/NCC.0000000000000889.
54. Grassi L, Spiegel D, Riba M. Advancing psychosocial care in cancer patients. F1000Res. 2017. https://doi.org/10.12688/f1000research.11902.1. 6:2083.
55. Oberoi D, Martopullo C, Bultz BD, Carlson LE. The effectiveness of a men-only supportive expressive group therapy intervention for psychosocial health outcomes in Gastrointestinal cancer patients: a 6-month longitudinal study. Health Qual Life Outcomes. 2021;19(1):47. https://doi.org/10.1186/s12955-021-01687-y.

Publisher's note