

# Efficacy of an Application-based Recurrence prevention Program for Breast Cancer Survivors: A Pilot study

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## Abstract

**Objectives:** To develop an application-based recurrence prevention program and to determine whether the program was effective in reducing symptom experience, increasing social support, and reducing uncertainty on breast cancer survivors.

**Methods/Statistical Analysis:** This is a quasi-experimental study with a non-equivalent control group pre-post test design. Twenty-seven breast cancer survivors with stage 0~II cancer identified within 24 months of completion of primary care treatment were recruited. Experimental group downloaded an application-based program on their smartphone and documented their diet, exercise and pain during 8 weeks. The data was analyzed using Fisher's exact test, Mann-Whitney U test, and Wilcoxon Signed Rank test. **Findings:** There is no significant difference between the two groups was evident in terms of any socio-demographic or clinical characteristics at the baseline. The experimental group had significantly lower scores for symptom experience ( $p = .044$ ), uncertainty ( $p = .043$ ) and higher scores for social support ( $p < .001$ ). According to the results, app-based uncertainty intervention program for breast cancer survivors was effective in reducing symptom experience, increasing social support, and reducing uncertainty. **Improvements/Applications:** In conclusion, an application-based recurrence prevention program for breast cancer survivors may give a help to health management as the utilization of smartphone is more extended

**Keywords:** Application-Based Recurrence Prevention Program, Breast Cancer, Symptom Experience, Social Support, Uncertainty

## 1. Introduction

### 1.1 Research Background

Breast cancer has the second highest incident rate, but with good prognosis and the five-year survival rate has been increased due the advance of medical technology<sup>1</sup>, resulting in the increase of the survival period after breast cancer diagnosis. According to the Korean Breast Cancer Society, the recurrence rate of breast cancer is 20 to 30%, and the recurrence takes place within 3 years after the surgery in 70.9% of the patients, and within 5 years after the surgery in 92% of the patients<sup>2</sup>.

Factors having positive effect on the health management and recurrence prevention after a breast cancer surgery are good diet, regular physical activity,

and good nutritional state, which are important parts of cancer treatment. The actions for recurrence prevention that are the most importantly recognized by breast cancer patients are also diet and physical exercise<sup>3</sup>. However, there is a gap between the belief about the importance and the actual practices, and thus many patients do not actually practice even though they may appreciate the importance of diet and physical exercise. Therefore, it is very important to change the life style through education<sup>4</sup>. In a study performed with breast cancer patients, diet control and physical exercise were performed, and the result showed that the subjects who practiced low-fat diet and took in vegetables and fruits had a lower recurrence rate<sup>5</sup>. In a 12-week study where web-based physical exercise and a diet self-management intervention

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program were provided by using customized motivation and action planning for breast cancer patients, the number of healthy actions and intake of vegetable and fruits were significantly increased<sup>6</sup>. In addition, it was shown that provision of a nutrition counseling program has the effect of decreasing total fat intake and increasing vegetable, fruit, and diet fiber intake<sup>7</sup>, indicating that there is a need for a breast cancer recurrence and metastasis prevention program which includes an education about diet and physical exercise and continued encouragement to help the patients to practice the diet and the physical exercise.

Various nursing interventions for breast cancer patients are currently conducted. As gathering many people to one place becomes more difficult and people's life becomes more individualized in this busy and complicated modern society, the internet-based program<sup>6</sup> has been proved effective. However, personal computers are limited with regard to portability and accessibility, a program based on a smart phone application may be necessary. The Korean Breast Cancer Society has already provided an application offering the guidelines for breast cancer patients, allowing them to download the application to obtain the information about the treatment and management of breast cancer. However, there has not been a study about a smart phone application-based program in Korea. Therefore, to help breast cancer patients to prevent the recurrence, the present pilot study was performed by developing an application-based breast cancer recurrence prevention program and verifying the effects of the program.

## 1.2 Objectives

The objectives of the study were to develop an application-based program for patients' health management and to apply the developed application-based program to breast cancer patients to verify the effects of the program.

## 2. Method

### 2.1 Process of Developing Application-based Recurrence Prevention Program for Breast Cancer Patients

The authors have worked in breast cancer-related wards for five years. According to the objectives of the study, by referring to the relevant literature<sup>6,8</sup> and cooperating with an application designer, an application-based recurrence

prevention program which enables a cancer patient to record the diet, physical exercise, and pain for the prevention of breast cancer recurrence and metastasis was developed. The languages used for the application-based program were PHP 5.2.16, jQuery 1.7.2, and JavaScript, the employed development tools were NetBeans 7.1, and Photoshop CS5. The application was tested on the web browsers including IE7, IE8, IE9, Firefox, Chrome, and Safari.

The developed program was an application-based program which enables to record the diet, physical exercise, and pain on a daily basis. The content of the program and the validity of the program procedure were assessed by one professor of the department of food and nutrition, two professors of the department of nursing, and two senior nursing officers in a university hospital. The average scores obtained by the assessment were 4.5 or higher, and thus the developed program was used as a research tool.

### 2.2 Research Design

This study was a pilot study to develop an application-based recurrence prevention program and to investigate the effects of the program on the symptom experience, social support, and uncertainty. The study was also designed as a non-equivalent control group pre-post test.

### 2.3 Subjects

To secure the ethicality, the study was reviewed by the Institutional Review Board (IRB) of the hospital (Review No. 2013-43). The subjects of the study were the breast cancer patients residing in the G city and the C country and undergoing outpatient treatment or nursing at the H Hospital, H Nursing Hospital, and L Clinic affiliated to the H Hospital. The research procedures and objectives of the study were explained to the subjects to obtain agreement. The written consent was read to the subjects or the subjects were asked to read the consent. The subjects from whom the written consent was received were included in the study. That the subjects who had already agreed to the participation could stop the participation at any time was not only clarified in the written consent but also orally informed to the subjects. The subjects were also informed that their responses were anonymous and would not be used for other purposes except the research. The number of subjects was 16 in the experimental group and 14 in the control group, but the number of subjects included in the final analysis was 27, since three out of the experimental group were dropped during the data collection

process. The subjects included in the study were the stage 0 to 2 breast cancer patients who had not yet passed two years since post-operational chemotherapy, and who had not experienced application-based diet diary keeping by using a smart phone.

## 2.4 Research Tools

The measurements were used in the study after receiving the approval of the ones who developed the inventories and the ones who revised them.

### 2.4.1 Symptom Experience Inventory

The symptom experience was measured by using the Symptom Experience Scale (SES)<sup>9</sup> revised for early breast cancer patients<sup>10</sup>. The frequency was measured in a five-point scale from 0 to 4, and the higher total score indicated a higher degree of symptom experience. The reliability represented by Cronbach's alpha coefficient was .94 when the inventory was firstly developed, .91 in Reference<sup>10</sup>, and .94 in the present study.

### 2.4.2 Social Support Inventory

The social support was measured by using the family support and medical team support inventory<sup>11</sup> revised for early breast cancer patients<sup>10</sup>. The inventory included 7 questionnaires about family support and 5 questionnaires about medical team support. The scale was developed in a five-point scale from 1 to 5, and the higher total score indicated a higher degree of recognized social support. The reliability of the family support and medical team support inventories represented by Cronbach's alpha coefficient was .82 and .91, respectively, when the inventory was firstly developed, .91 and .91<sup>10</sup> respectively, and .94 and .89 in this study respectively.

### 2.4.3 Uncertainty Inventory

The uncertainty was measured on the basis of the Mishel Uncertainty in Illness scale (MUIS)<sup>11</sup> which originally included a total of 30 questionnaires about four sub-concepts of uncertainly: Ambiguity, complexity, inconsistency, and unpredictability. The MUIS revised and supplemented by Reference<sup>10</sup> was employed including a total of 19 questionnaires: 11 questionnaires about ambiguity, 4 questionnaires about complexity, and 4 questions about unpredictability. The scale was determined in a five-point scale from 1 to 5, and the higher total score indicated a higher degree of uncertainty. The reliability

represented by Cronbach's alpha coefficient was .70 to .91 when the inventory was firstly developed<sup>12</sup>, .61 to .79<sup>10</sup>, and .64 to .88 in this study.

## 2.5 Content and Procedures of Application-based Recurrence Prevention Program

The content and the procedures of the application-based recurrence prevention program are shown in Table 1.

## 2.6 Methods of Data Collection

The subjects undergoing outpatient treatment or nursing at the H Hospital, H Nursing Hospital, and L Clinic were given explanation about the research objective through individual interviews performed by the researchers, and signed written consent was received from the subjects. Then, the subjects were instructed to download on their smart phones and use the application-based program. In addition, a group education was provided to explain the research objectives and the methods of recurrence prevention. The general characteristics and the disease-related characteristics of the subjects were investigated. The research variables including symptom experience, social support, and uncertainty were measured by using self-reporting questionnaires. The experiment was performed for 8 weeks. The subjects were asked to record the diet, physical exercise, and pain by using smart phones. The researchers checked the records reported by the subjects through the administrator screen and sent an encouragement text message once a week. On the fourth and eighth weeks, counsels about breast cancer and the application program as well as feedbacks were provided by telephone visits. As the post investigation, appointments for interviews by outpatient visit or hospitalization were arranged on the eighth week of the experiment through telephone visit, and the symptom experience, social support, and uncertainty were measured by using the questionnaires. The experiences of using the application program were shared, and the subjects were encouraged to use the downloaded application program even after the end of the study for self-management.

## 2.7 Methods of Data Analysis

The collected data were analyzed by using SPSS Win 18.0 software. The general characteristics and the disease-related characteristics of the subjects were measured by frequency percentage. The homogeneity of the experimental group and the control group was tested by

**Table 1.** App-based recurrence prevention program

	Contents	Time/Instrument	Strategy
	Information of program and study propose	twenty minute/	credible authority
	Informed consent taken	Informed consent	education, self check
	Education about management of post operation	thirty minute/	social support
	Prevention of recurrence & metastasis	handout	
	Diet/Exercise/& Lymph massage/ Symptom management	ppt	
1wk	Explanation about app-program	twenty minute/	
	App download & education	smart phone	
	Documentation of diet kind/amount		
	Documentation of pain severity / frequency/ duration		
	Documentation of exercise kind/time/intensity		
2~3wk	Encourage & support	five minute /once/week	credible authority
	Feedback about documentation (diet/pain/exercise)	mobile_SMS	social support
	Symptom management		symptom management
4wk	Feedback about documentation (diet/pain/exercise)	ten minute/	credible authority
	Encourage & support to use of program	telephone coaching	social support
	Education about symptom management		symptom management
5~7wk	Encourage & support	five minute/ /once/week	credible authority
	Feedback about documentation (diet/pain/exercise)	mobile_SMS	social support
8wk	Feedback about documentation (diet/pain/exercise)	ten minute /telephone coaching	credible authority
	Preparation to termination of program		social support

performing the Fisher's exact test and the Mann-Whitney U test. The homogeneity of the result variables was tested by performing the Mann-Whitney U test. The pre-post test of the experimental group and the control group was performed through the Mann-Whitney U test and the Wilcoxon signed ranks. The significance level of all the statistical data was  $p < .05$ .

### 3. Results

#### 3.1 Subject Homogeneity Test

The homogeneity of the general characteristics of the subjects was tested, and the result showed that there was not a significant difference between the two groups, indicating that the two groups were homogenous (Table 2).

Exp: Experimental group Cont. : Control group

\*: Fisher's exact test

#### 3.2 Effects of an Application-based Recurrence Prevention Program

Table 3 shows the results about the effects of the application-based recurrence prevention program.

##### 3.2.1 Symptom Experience

With respect to the pre-post difference of the experimental group and the control group, the Mean rank of the experimental group was 10.81 and that of the control group was 16.96, indicating that the Mean rank do the two groups was statistically significant ( $z = -2.02$ ,  $p = .044$ ).

**Table 2.** Homogeneity of general and disease related characteristics between experimental and control group

Characteristics	Exp.(n=13) No.(%)	Cont.(n=14) No.(%)	Z or $\chi^2$	p
<b>Age(yr)</b>				
30~49	4(30.8)	5(35.5)	-1.15	.251
≥50	9(69.2)	9(64.2)		
M ± SD	48.00±7.63	51.71±5.68		
<b>Marital status</b>				
Married	12(92.3)	14(100)	-1.04	.481
Widowed	1(7.7)	0(0)		
<b>Job</b>				
Have	4(30.8)	1(7.1)	.142	.165
Have not	9(69.2)	13(92.9)		
<b>Education level</b>				
Junior & high school	6(46.2)	8(57.1)	.81	.808
College and over	7(53.8)	6(42.6)		
<b>Religion</b>				
Have	11(76.9)	8(57.4)	-1.65	.215
Have not	3(23.1)	6(42.6)		
<b>Income(10,000won)</b>				
<200	7(53.9)	8(57.4)	.20	.105
≥200	6(46.1)	6(42.6)		
<b>Number of child</b>				
1	2(15.4)	2(14.2)	.749	.793
2	9(69.2)	9(64.3)		
3	2(15.4)	3(21.4)		
<b>BMI *</b>				
18.5~22.9	7(53.8)	7(50.0)		.291
23~24.9	4(30.8)	4(28.4)		
>25	2(15.4)	3(24.3)		
M ± SD	22.66±2.46	23.65±3.08		
<b>Family history</b>				
Yes	1(7.7)	5(40.5)	.19	.077
No	12(92.3)	9(59.5)		
<b>Duration after diagnosis(months) M ± SD</b>	11.57±1.49	12.29±2.12	-1.43	.154
<b>Clinical stage *</b>				
Stage 0	3(23.1)	1(7.1)		.368
Stage I	2(15.4)	5(35.7)		
Stage II	8(61.5)	8(57.1)		
<b>Surgery type</b>				
Breast-Conserving Surgery	8(61.5)	8(57.1)	-.23	.820
Mastectomy	5(38.5)	6(42.9)		

**Table 3.** Comparison of subcategories in symptom experience, social support, and uncertainty between experimental and control group

Variabels	categories		Experimental group (n=13)	Control group (n=14)	Z	p
			Mean rank	Mean rank		
Symptom experience		Pretest	13.27	14.68	-2.02	.044
		Posttest	9.88	17.82		
		Difference	10.81	16.96		
Social support		Pretest	15.92	12.21	-3.52	< .001
		Posttest	18.58	9.75		
		Difference	19.54	8.86		
	Family support	Pretest	16.42	11.75	-2.79	.005
		Posttest	18.19	10.11		
		Difference	18.31	10.00		
	Medical staff support	Pretest	15.08	13.00	-2.98	.003
		Posttest	18.46	9.86		
Uncertainty		Difference	18.65	9.68		
		Pretest	13.12	14.82	-1.85	.043
		Posttest	10.46	17.29		
		Difference	11.08	16.71		
	Ambiguity	Pretest	12.19	15.68	-1.27	.104
		Posttest	10.54	17.21		
	Difference	12.00	15.86			
	Complexity	Pretest	16.00	12.14	-.12	.801
		Posttest	15.77	12.36		
		Difference	12.00	15.86		
	Unpredictability	Pretest	14.85	13.21	-2.41	.016
		Posttest	12.54	15.36		
		Difference	10.27	17.46		

### 3.2.2 Social Support

With respect to the pre-post difference of the experimental group and the control group, the Mean rank of the experimental group was 19.54 and that of the control group was 8.86, indicating that the Mean rank of the two groups was statistically significant ( $z = -3.52, p < .001$ ).

### 3.2.3 Uncertainty

With respect to the pre-post difference of the experimental group and the control group, the Mean rank of the experimental group was 11.08 and that of the control group was 16.71, indicating that the Mean rank of the two groups was statistically significant ( $z = -1.85, p = .043$ ).

## 4. Discussion

The symptom experience score of the experimental group to which the application-based recurrence prevention program was applied was significantly lower than that of the control group. This result was similar to the result of another study that the psychological symptom distress was significantly reduced in comparison with the control group by applying a psycho-educational support program for breast cancer patients, consisting of face-to-face interview, telephone health counseling, and small-group meeting<sup>13</sup>. Although there are rare cases where a nursing intervention program is applied to breast cancer patients to verify the effect of decreasing symptom experiences, it

was verified in the present study that the psychological, educational, and social support program for the cancer patients, consisting of face-to-face interview, telephone health counseling, and mutual health communication applications, had the effect of decreasing the symptom experiences.

In this study, the social support score of the experimental group to which the application-based recurrence prevention program was applied was significantly higher than that of the control group. Social support is one of the predictors having a direct effect on the adaptation of cancer patients undergoing chemotherapy<sup>14</sup>, and thus social support is very important to the subjects who have to live their remaining life with breast cancer. Since the medical team support for breast cancer patients is relatively low in comparison with the family support<sup>15</sup>, it may be necessary to not only induce family participation but also extend the medical team support in providing a program for breast cancer patients. In this study, text messages encouraging the subjects were sent on the basis of the records of the diet, physical exercise, and pain. On the fourth and eighth weeks of the experiment, counseling was provided by telephone visits to hear about the difficulties of post-management, answer the questions, and present overall feedbacks about the utilization of the application program. In this study, the social support score of the experimental group was significantly increased after applying the program, indicating that such a nursing intervention may increase both the family support and medical team support, which are the sub-categories of social support, resulting in the improvement of the quality of life or psycho-social adaptation of breast cancer patients.

In this study, the uncertainty score of the experimental group to which the application-based recurrence prevention program was applied was significantly lower than that of the control group. In a previous study<sup>16</sup>, a nursing education material according to evidence based nursing guidelines, a brochure entitled "Anticancer Self-Nursing for Breast Cancer Patients", was provided to the breast cancer patients undergoing the first anticancer therapy, and a relevant education was provided to the individual patients, resulting in an increase of self-care and a decrease of uncertainty. However, in that previous study, the significant decrease was found in complexity, one of the sub-concepts of uncertainty, different from the result of this study. Since there has not been a similar study about the effect of precedence factor or program on ambiguity, complexity, unpredictability, and information deficiency,

which are sub-concepts of uncertainty, the further studies may need to be conducted in this regard.

The analysis of the diet record data of the experimental group to which the application-based recurrence prevention program was applied showed that the kinds of vegetable that the subject took in one day was increased from 4.93 of the first week to 6.38 to the eighth week, and the kinds of fruits was increase from 3.30 of the first week to 4.84 to the eighth week. Considering that the Korean Breast Cancer Society recommends to take in six or more kinds of vegetables and four or more kinds of fruits everyday, the subjects may be recognized to have maintained healthy diet. This result of the study partially supports the result of a previous study where customized motivation and action planning for breast cancer patients were used to provide web-based physical exercise and diet self-management program for 12 weeks that the vegetable and fruit intake was significantly increased in the experimental group<sup>6</sup>. The result also supports the previous result that a nutrition counseling program had the effect of decreasing total fat intake and increasing vegetable, fruit, and dietary fiber intake<sup>7</sup>. The records of physical exercise showed that six of the patients did physical exercise once a week (46.2%), one patient three times a week (7.1%), and four patients five times a week (30.8%). The types of physical exercise, even though these were overlapped, walking was the most, followed by hiking, cycling, and swimming. The duration of physical exercise at one time was increased from 29.23 min of the first week to 43.07 minutes of the eighth week, indicating that the application-based recording had a positive effect on the life pattern including diet and physical exercise. This result was consistent with a previous report that most of breast cancer survivals do physical exercise, mostly three to five times a week, for 31 to 60 minutes at a time, doing walking, hiking, swimming, and cycling<sup>3</sup>. The result verified that the application-based recurrence prevention program of the present study may be an effective nursing intervention for the health management and recurrence prevention for breast cancer patients.

The limitation of this study was that sufficient demonstration should have been required before the utilization of the application-based program since use of a smart phone needs some skills. In addition, since this study is the first time when an application-based program was applied to breast cancer patients, a further study with a greater number of subjects is suggested to verify the validity of the results.

## 5. Conclusions

This study provided a program for breast cancer patients to perform self-examination of diet and physical exercise which are considered as the most important factors of recurrence prevention. The results showed that the program had an effect of decreasing symptom experience, increasing social support, and decreasing uncertainty, indicating that the application-based program may be an effective nursing intervention in decreasing the uncertainty of metastasis or recurrence which are experienced by breast cancer patients within two years after the surgery. As the program for breast cancer patients are developed as a nursing intervention which is more individualized and customized on the basis of the internet, the level of nursing practices may be elevated. The application-based program of this study may give a great help to health management as the utilization of smart phones is more extended in the future.

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