



저작자표시-비영리-변경금지 2.0 대한민국

이용자는 아래의 조건을 따르는 경우에 한하여 자유롭게

- 이 저작물을 복제, 배포, 전송, 전시, 공연 및 방송할 수 있습니다.

다음과 같은 조건을 따라야 합니다:



저작자표시. 귀하는 원저작자를 표시하여야 합니다.



비영리. 귀하는 이 저작물을 영리 목적으로 이용할 수 없습니다.



변경금지. 귀하는 이 저작물을 개작, 변형 또는 가공할 수 없습니다.

- 귀하는, 이 저작물의 재이용이나 배포의 경우, 이 저작물에 적용된 이용허락조건을 명확하게 나타내어야 합니다.
- 저작권자로부터 별도의 허가를 받으면 이러한 조건들은 적용되지 않습니다.

저작권법에 따른 이용자의 권리는 위의 내용에 의하여 영향을 받지 않습니다.

이것은 [이용허락규약\(Legal Code\)](#)을 이해하기 쉽게 요약한 것입니다.

[Disclaimer](#)

의학석사 학위논문

**Effect of short message service as a reminder
for breast self-examination in breast cancer
patients: a randomized controlled trial**

휴대전화 문자메시지를 이용한 알림
서비스가 유방암 환자의 유방자가검진
행태에 미치는 효과
: 무작위배정 대조군 연구

2013년 2월

서울대학교 대학원
의학과 외과학 전공
정 일 용

의학석사 학위논문

**Effect of short message service as a reminder
for breast self-examination in breast cancer
patients: a randomized controlled trial**

휴대전화 문자메시지를 이용한 알림
서비스가 유방암 환자의 유방자가검진
행태에 미치는 효과
: 무작위배정 대조군 연구

2013년 2월

서울대학교 대학원
의학과 외과학 전공
정 일 용

**Effect of short message service as a
reminder for breast self-examination
in breast cancer patients: a
randomized controlled trial**

February 2013

Chung Il Yong

Department of Surgery

College of Medicine

The Graduate School

Seoul National University

휴대전화 문자메시지를 이용한 알림
서비스가 유방암 환자의
유방자가검진 행태에 미치는 효과:
무작위배정 대조군 연구

지도 교수 김 성 원

이 논문을 의학석사 학위논문으로 제출함
2012년 12월

서울대학교 대학원
의학과 외과학 전공
정 일 용

정일용의 의학석사 학위논문을 인준함
2012년 12월

위 원 장 _____ (인)

부위원장 _____ (인)

위 원 _____ (인)

**Effect of short message service as a reminder
for breast self-examination in breast cancer
patients: a randomized controlled trial**

by

Il Yong Chung

**A thesis submitted to the Department of Surgery in
partial fulfillment of the requirements for the Degree
of Master of Science in Surgery at Seoul National
University College of Medicine**

December 2012

Approved by Thesis Committee:

Professor _____ Chairman

Professor _____ Vice chairman

Professor _____

ABSTRACT

Introduction: To assess the effectiveness of short message service (SMS) as a reminder for breast self-examination (BSE) in patients who underwent breast cancer surgery.

Methods: This study was a single-blind, parallel group, randomized controlled trial of the effect of SMS on adherence to BSE. Participants who underwent surgery for breast cancer were recruited from the Breast Care Center at Seoul National University Bundang Hospital. Patients were eligible if they were women between the ages of 20 and 65 years and had their own cellular phone with text-message features. Participants were randomized by block randomization to the intervention (SMS) group or the control group. Subjects in the SMS group received one text message on the first day of every month that reminded them to complete a monthly BSE and one text message on the fifteenth day of that contained information about breast cancer. During the follow-up visit, researchers who were blind to participants' allocations conducted post-intervention assessments. Primary and secondary outcomes were self-reported BSE adherence and the frequency of BSE over 6 months.

Results: Between August 2010 and December 2011, 216 patients were randomly assigned to the SMS group (n = 110) or the control group (n =

106). A total of 202 patients were included in the final analysis. Self-reported BSE adherence (relative risk [RR] for non-adherence 0.49, 95% CI 0.36 to 0.67; $P < 0.001$) and the frequency of BSE over the past six months (mean difference 1.66, 95% CI 1.03 to 2.29; $P < 0.001$) were significantly higher in the intervention group than in the control group. Multivariate analysis showed that the SMS intervention was the only significant factor for self-reported BSE adherence ($n = 199$, odd ratio [OR] 4.08, 95% CI 2.24 to 7.43; $P < 0.001$). There were no reports of harmful effects of the intervention from participants.

Conclusions: The short-term results of our study suggest that SMS reminders are an effective and low-cost method to enhance adherence to BSE by using existing information technology infrastructure.

Trial Registration: Clinical Research Information Service KCT0000018

Keywords: Breast cancer, Randomized controlled trial, Breast self-examination, Short message service

Student Number: 2010-23702

CONTENTS

Abstract	i
Contents	iii
List of Tables & Figures	
List of Tables	iv
List of Figures	v
Introduction... ..	1
Materials and Methods.....	6
Results	12
Discussion	22
Conclusions	28
Competing interests	29
References	30
Abstract – Korean.....	37
Acknowledgement	39

List of Tables

Table 1. Baseline characteristics of the study participants

Table 2. Self-reported BSE adherence and frequency of BSE in the SMS
and control groups

Table 3. Subgroup analysis of self-reported BES adherence and frequency
of BSE

List of Figures

Fig.1 Flowchart of recruitment progress of study participants

Fig.2 Mean monthly BSE adherence rates of the SMS and control groups

The monthly adherence rates of the two groups were different from the first month through the end of the study ($P < 0.001$).

INTRODUCTION

Breast self-examination (BSE) encourages women to become more aware of their own breasts and enhances breast cancer awareness, according to several guidelines. (1, 2) The National Comprehensive Cancer Network (NCCN) guidelines suggest that women should be familiar with their own breasts, since this familiarity may facilitate detection of interval cancers between routine screenings, and periodic BSE may promote such breast awareness. (3) Moreover, American Society of Clinical Oncology (ASCO) guidelines suggest that breast cancer survivors should be encouraged to perform monthly BSE, although this is not a universal recommendation for high risk groups. (4)

The efficacy of BSE for breast cancer screening is controversial. Some guidelines do not recommend BSE in women at normal risk. The recent recommendations of the U.S. Preventive Services Task Force (USPSTF), published in November 2009, do not recommend breast self-examination and the Guidelines of Canadian Task Force on Preventive Health Care, issued in 2005, also do not support breast self-examination for women between the ages of 40 and 69 years. (5, 6) A large,

randomized controlled trial showed that teaching and practicing BSE periodically for about 5 years had no effect on breast cancer mortality and only increased the biopsy rate of benign lesions. (7, 8) However, the trial was a study of the teaching of BSE, not of the practice of BSE. Authors suggested that the results of their study should be interpreted cautiously and highly motivated women who practiced BSE competently and frequently could detect interval cancers between routine check-ups which would be benefited by the diligent practice of BSE. Moreover, the participants in this trial were female employees in textile factories who seemed to represent women at average risk for breast cancer, and thus the results should not be generalized to women at high risk and breast cancer survivors. So far, there has been no study investigating the effect of BSE for high-risk groups and it is recommended to perform BSE in these groups by other guidelines. (4)

Many studies have focused on improving adherence to BSE. (9, 10) These studies assessed the ability of reminders, such as telephone calls, postcards and prompts on oral contraceptive packaging, to influence the rate of BSE among women at normal risk for breast cancer. Overall, the reminder groups had a higher rate of BSE than the control groups. (11, 12) Recently, one study showed that reminders sent by short message

service (SMS) significantly increased the rate of BSE after the first two months of intervention. This study was not a randomized controlled trial and a total of 106 women at normal risk were sent according to the last menstrual period to premenopausal women and the first day of every month to postmenopausal women. After the first two months of sending reminder, the practice of BSE increased significantly (42.4% vs. 67.9%, $P < 0.05$). (13)

Programs that use mobile communication services are emerging with the aim of supporting health systems. (14-16) In a randomized controlled trial, which was conducted in Kenya and investigated the effects of SMS on antiretroviral treatment adherence, 538 HIV-infected adults were randomized into SMS intervention or standard care group. After 6 and 12 months follow-up, self-reported antiretroviral treatment adherence and plasma HIV-1 viral RNA load suppression were checked. There was a significant difference in adherence to antiretroviral treatment (relative risk for non-adherence 0.81, 95% CI 0.69 to 0.94; $P = 0.006$) and suppressed viral loads (relative risk for virologic failure 0.84, 95% CI 0.71 to 0.99; $P = 0.04$) between the two groups and the authors suggested that mobile phones can be effective tools to improve patient outcome in developing countries. (15)

SMS interventions have already shown positive short-term behavioral outcomes. (17-19) The efficacy of SMS interventions has been investigated in several randomized controlled trials that showed that SMS was a productive and cost-effective channel of communication to promote behaviors that support weight loss in overweight adults and improve adherence to sunscreen application. (20-23) Some researchers investigated the effectiveness of SMS as a reminder for improving adherence to sunscreen application. A total of 70 participants were randomly assigned to an intervention group or a control group. Adherence to sunscreen was assessed using an electronic device and the SMS intervention group showed a higher daily adherence rate than the control group (56.1% vs. 30.0%, $P = 0.001$). (21) Other researchers investigated whether weight loss can be achieved in overweight adults through the SMS intervention. Over the 4-month intervention period, a total of 75 overweight participants were randomized into one of the two groups and there was a significant difference in weight change between the control group and the intervention group (-1.97 kg difference, 95% CI -0.34 to -3.60 kg, $P = 0.02$). (23)

We hypothesized that SMS interventions would be more effective than usual care in enhancing adherence to BSE. This trial aimed to assess

the effectiveness of SMS as a reminder for BSE in patients who underwent breast cancer surgery.

MATERIALS AND METHODS

Subjects

Participants who underwent surgery for breast cancer were recruited from the Breast Care Center at Seoul National University Bundang Hospital. Patients were eligible for study participation if they were women between the ages of 20 and 65 years and had their own cellular phone with text-message features. Those who had distant metastasis or recurrent breast cancer and those who had no capability of using a cellular phone were excluded.

Written informed consent was obtained from all patients at enrollment. The study protocol was approved by the Institutional Review Board at Seoul National University Bundang Hospital (B-1006/103-301). This trial is registered with the Clinical Research Information Service (CRIS), Republic of Korea (KCT0000018).

Study procedures

This study was a single-blind, parallel group, randomized controlled trial. Block randomization into two arms was completed in blocks of 10

patients using a computer. Patients were randomly assigned to the intervention group or the control group with the help of a research nurse who did not participate in creating the random numbers. Participants and the research nurse could not be masked because the intervention required overt participation; however, during clinical checkup in the outpatient clinic, researchers who carried out post-intervention assessments were blind to the patients' allocations. Fig. 1 shows the trial procedure.

Currently, the Breast Care Center at Seoul National University Bundang Hospital maintains a website that provides a free text-messaging service as a reminder for BSE (www.ubreast.kr). The website has gained more than 3,000 members since its start in April 2007. The website delivers one text message on the first day of every month to remind patients to complete a monthly BSE (e.g. Breast self-exams help to detect breast cancer early. Keep your breast healthy.) and another text message on the fifteenth day of every month that contains information about breast cancer (e.g. If you have eczema on your nipple, go to see a doctor). We used this website to send text messages to participants who were allocated to the SMS intervention group.

At the first meeting, which took place postoperatively during the hospital stay, a BSE educational session that included educational leaflets,

watching a video and BSE practice with a breast model was offered to every participant by the research nurse. Each participant was provided with a self-reporting checklist of monthly BSE. They were asked to write down the date of the BSE every month and bring the checklist back to the clinic at 3- and 6-month follow-up appointments. We assessed anxiety about breast cancer recurrence using a five-level Likert scale (strongly agree, agree, neutral, disagree, strongly disagree), as well as the frequency of previous monthly BSE prior to participation in this trial. Then, participants were randomized to one of the two groups. Patients in the SMS intervention group were registered to the above-mentioned website with the help of the research nurse.

At 3- and 6-months follow-up, when each patient visited the breast cancer clinic for a postoperative checkup, the self-reported checklists were evaluated to verify the date and frequency of monthly BSE. Participants who did not bring the self-reported checklists were asked whether they recalled the exact date of BSE and how many times they had performed monthly BSE in the previous 3 months. According to the verification of checklists and their responses, participants were subdivided into three subgroups: “checklist”, “recall” and “uncertainty”. The checklist subgroup consisted of participants who brought back the

checklists at both 3 and 6 months. The recall subgroup consisted of participants who recalled the exact date of BSE at both 3 and 6 months, even though they did not bring the checklists. Participants who did not recall the exact date of BSE and did not bring the checklists were classified to the uncertainty subgroup.

Statistical analysis

The sample size was calculated based on a previous study that investigated the rate of BSE between groups with and without reminders that included letters or telephone calls and showed a significant difference in adherence rates of 81% and 62% between the treatment and control groups, respectively. (12) A total sample size of 216 was needed to detect a significant improvement in adherence, with a two-sided 5% significance level, a power of 80%, and 10% drop-out rate.

Demographic factors and clinicopathologic characteristics were analyzed with the χ^2 test and Student's t-test. TNM classification of breast cancer was evaluated according to the seventh edition of the American Joint Committee on Cancer (AJCC) Staging Manual. The pathologic T stage (pT) was divided into T0-T1 or T2-T3. The pathologic N stage (pN) was divided into N0 and N1-N3. Anxiety about breast cancer recurrence

was dichotomized into “Yes”, which included “strongly agree” and “agree”, and “No”, which included “neutral”, “disagree” and “strongly disagree”. The frequency of BSE before participation was subdivided into “monthly” and “less than monthly”.

The primary outcome was self-reported BSE adherence. Participants were categorized as adherent if they reported that they had conducted monthly BSE five or six times over the past 6 months. We analyzed the primary outcomes with the χ^2 test. The secondary outcome was the frequency of BSE, which was assessed after 6 months follow-up using Student's t-test. In order to identify the factors that had an effect on self-reported BSE adherence, we used a binary logistic regression model for analysis.

Monthly adherence rates, which were the mean numbers of patients who conducted BSE each month, were compared between the two groups using the χ^2 test. The frequencies of BSE before and after participation were assessed using the Student's t-test.

For subgroup analysis, self-reported BSE adherence rates and frequencies of BSE of the three subgroups (checklist, recall and uncertainty) were analyzed with the χ^2 test, Fisher's exact test and Student's t-test. Because patients returned to the clinic at 3- and 6-months

follow-up, they were more likely to correctly recall the date of BSE in the third and sixth months. To minimize the effect of a recall bias, we assessed the monthly adherence rates at the third and sixth months in the recall subgroup to analyze the effects of the invention.

For all models, the results were expressed with 95% CIs or P values. All statistical analyses were performed with SPSS statistical software system version 15.0 for Windows software (SPSS Inc., Chicago, USA).

RESULTS

Participants' characteristics

Between August 2010 and December 2011, we assessed 399 participants for eligibility (Figure 1). After screening, 183 patients were excluded, based on the exclusion criteria. Accordingly, 216 patients were randomly assigned to the SMS intervention group (n=110) and the control group (n=106). Four participants (three in the SMS group and one in the control group) were lost to follow-up without identifiable cause. Ten participants discontinued the intervention after random allocation for several reasons. In the SMS group, the reasons were SMS delivery failure due to the wrong number in 3 cases, a postoperative wound problem in 1 case and another medical problem (cerebral infarct) in 1 case. In the control group, reasons for discontinuation included a postoperative wound problem in 1 case, another medical problem (subarachnoid hemorrhage) in 1 case, distant metastasis in 1 case, second primary cancer in 1 case and withdrawal because of simple inconvenience in 1 case. The total attrition rate was 6.5 % (7.3% in the SMS group and 5.7% in the control group) and these 14 patients were excluded from the final analysis. Table 1 presents the demographics and baseline characteristics of all the

participants. There were no significant differences between the groups except for educational level.

Adherence and frequency of BSE

More patients in the SMS group than in the control group were adherent to BSE. Self-reported BSE adherence and the frequency of BSE over the past six months were significantly higher in the intervention group than in the control group (Table 2). After adjusting for educational level, which was significantly different between the two groups in the univariate analysis, the SMS intervention was the only significant factor for self-reported BSE adherence in the multivariate analysis (odds ratio [OR] 4.08, 95% CI 2.24 to 7.43; $P < 0.001$). Higher education was not associated with a significant difference in self-reported BSE adherence (58.3% vs. 46.6%; $P = 0.098$) or frequency of BSE (4.1 ± 2.3 vs. 3.5 ± 2.4 ; $P = 0.087$) between the SMS and control groups in the univariate analyses. After adjustment, a college degree or higher was not a significant factor for BSE adherence or frequency (OR 1.32, 95% CI 0.73 to 2.40; $P = 0.363$).

The monthly BSE adherence rates in the SMS and control groups are shown in Fig. 2. The monthly adherence rates of the two groups were different from the first month through the end of the study period ($P <$

0.001). The frequencies of BSE before participation were not different between the SMS and control groups (1.4 ± 2.2 vs. 1.4 ± 2.2 ; $P = 0.980$). By contrast, the frequencies of BSE after participation were significantly different between groups (Table 2).

Subgroup analysis

Subgroup analysis revealed that, in the checklist subgroup, there were no significant differences in self-reported BSE adherence or frequency of BSE following the SMS intervention. However, the recall subgroup showed a significant difference between the two groups (Table 3). In the recall group, the monthly adherence rates of the SMS and control groups were 71.2% and 28.6% ($P < 0.001$) at the third month and 76.3% and 31.0% ($P < 0.001$) at the sixth month, respectively. These results indicate significant differences in BSE adherence following the SMS intervention.

Both the SMS and control groups were divided according to education level for subgroup analysis. In the college degree or higher ($n = 103$) and less than a college degree ($n = 96$) subgroups, there were no significant differences in self-reported BSE adherence or frequency of BSE following the SMS intervention (data not shown).

There were no reports of any harmful effects of the interventions

from participants. Ten participants withdrew from the study for the previously-mentioned reasons, which seemed to be unrelated to the SMS intervention.

Table 1. Baseline characteristics of the study participants

		SMS group		Control group		P value
		(n=102)		(n=100)		
		N	(%)	N	(%)	
Age, mean(SD), y		46.5	(8.5)	46.1	(8.8)	0.743
Surgery (Breast)	Mastectomy	36	(35.3)	31	(31.0)	0.517
	BCS	66	(64.7)	69	(69.0)	
Surgery (Axilla)	ALND	30	(29.4)	31	(31.0)	0.908*
	SLNB	68	(66.7)	64	(64.0)	
	Not done	4	(3.9)	5	(5.0)	
Chemotherapy	Yes	76	(74.5)	71	(71.0)	0.575
	No	26	(25.5)	29	(29.0)	
Radiation therapy	Yes	71	(69.6)	67	(67.0)	0.690
	No	31	(30.4)	33	(33.0)	
Hormonal therapy	Yes	74	(72.5)	70	(70.0)	0.689
	No	28	(27.5)	30	(30.0)	
Targeted therapy	Yes	20	(19.6)	25	(25.0)	0.357
	No	82	(80.4)	75	(75.0)	
Pathologic T stage	T0-1	76	(74.5)	72	(72.0)	0.687
	T2, T3	26	(25.5)	28	(28.0)	
Pathologic N stage	N0	67	(65.7)	67	(67.0)	0.878*
	N1-N3	31	(30.4)	28	(28.0)	
	Unknown	4	(3.9)	5	(5.0)	
Menopause	Pre	73	(71.6)	78	(78.0)	0.372*
	Post	28	(27.5)	22	(22.0)	
	Unknown	1	(1.0)	0	(0.0)	
Family history of breast cancer	Yes	5	(4.9)	8	(8.0)	0.370
	No	97	(95.1)	92	(92.0)	

Smoking	Yes	6 (5.9)	8 (8.0)	0.554
	No	96 (94.1)	92 (92.0)	
Alcohol	Yes	31 (30.4)	28 (28.0)	0.709
	No	71 (69.6)	72 (72.0)	
Education	<College	44 (43.1)	59 (59.0)	0.031*
	≥College	57 (55.9)	39 (39.0)	
	Unknown	1 (1.0)	2 (2.0)	
Occupation	Yes	51 (50.0)	44 (44.0)	0.545*
	No	49 (48.0)	55 (55.0)	
	Unknown	2 (2.0)	1 (1.0)	
Marital status	Yes	95 (93.1)	93 (93.0)	0.890*
	No	6 (5.9)	7 (7.0)	
	Unknown	1 (1.0)	0 (0.0)	
Childbirth	0	11 (10.8)	11 (11.0)	0.193*
	1≤	87 (85.3)	89 (89.0)	
	Unknown	4 (3.9)	0 (0.0)	
Breast feeding	Yes	54 (52.9)	59 (59.0)	0.131
	No	33 (32.4)	35 (35.0)	
	Unknown	15 (14.7)	6 (6.0)	
Anxiety about recurrence	Yes	19 (18.6)	17 (17.0)	0.763
	No	83 (81.4)	83 (83.0)	
BSE before participation†	Monthly	15 (14.7)	14 (14.0)	0.886
	<Monthly	87 (85.3)	86 (86.0)	

* Fisher's exact test

BCS: Breast conserving surgery; ALND: Axillary lymph node dissection; SLNB: Sentinel lymph node biopsy; BSE: Breast self examination

Table 2. Self-reported BSE adherence and frequency of BSE in the SMS and control groups

Primary outcomes				
	SMS group (n=102)	Control group (n=100)	Relative risk (95% CI)	P value
Self-reported adherence ($5 \leq$)	70 (68.6)	35 (35.0)	0.49 (0.36-0.67)	<0.001
Secondary outcomes				
	SMS group (n=102)	Control group (n=100)	Mean difference (95% CI)	P value
Frequency of BSE, mean (SD)	4.6 (2.1)	2.9 (2.4)	1.66 (1.03-2.29)	<0.001

Table 3. Subgroup analysis of self-reported BES adherence and frequency of BSE

	SMS group (n=102)	Control group (n=100)	P value
Self-reported adherence (5≤)			
Checklist (n=33)	9 (69.2)	13 (65.0)	1.000*
Recall (n=101)	36 (61.0)	7 (16.7)	<0.001
Uncertainty (n=68)	25 (83.3)	15 (39.5)	<0.001*
Frequency of BSE, mean (SD)			
Checklist (n=33)	4.8 (1.7)	4.3 (2.0)	0.430
Recall (n=101)	4.2 (2.3)	1.7 (2.3)	<0.001
Uncertainty (n=68)	5.2 (1.7)	3.6 (2.2)	0.001

*Fisher's exact test

Figure 1. Flowchart of recruitment progress of study participants

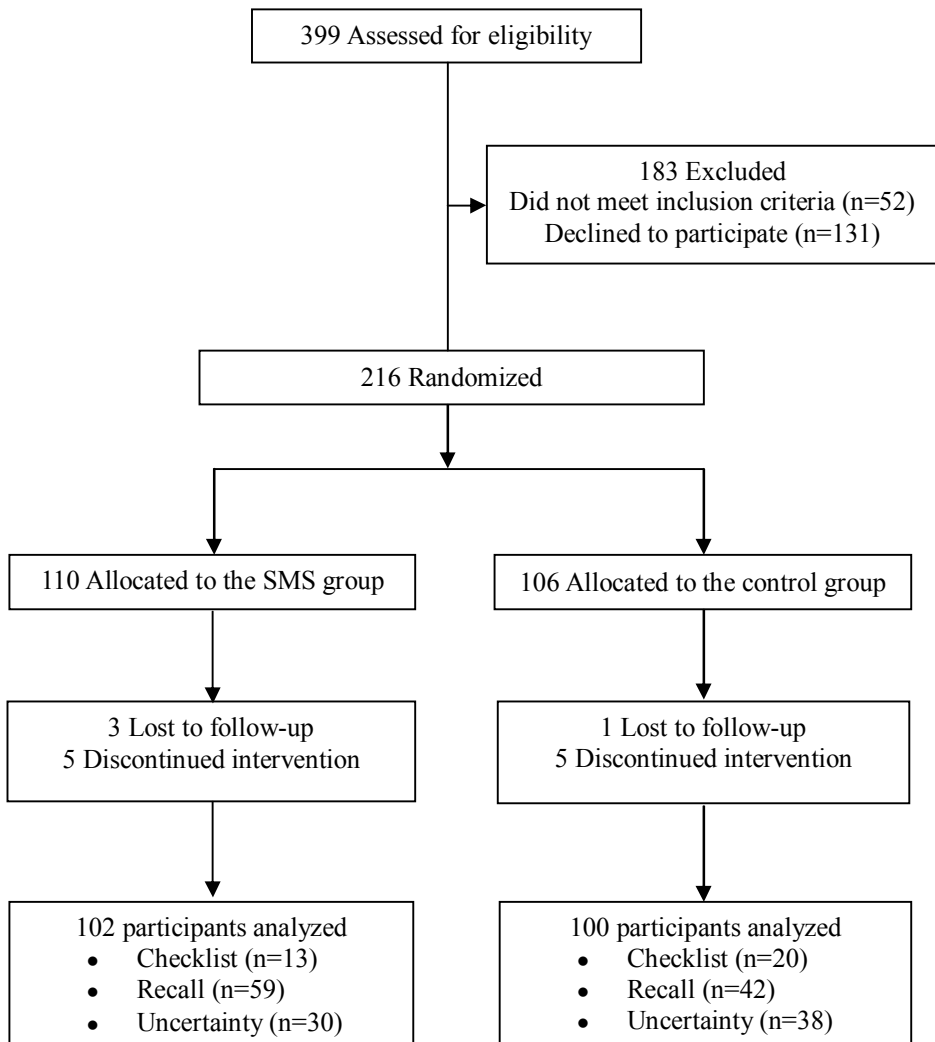
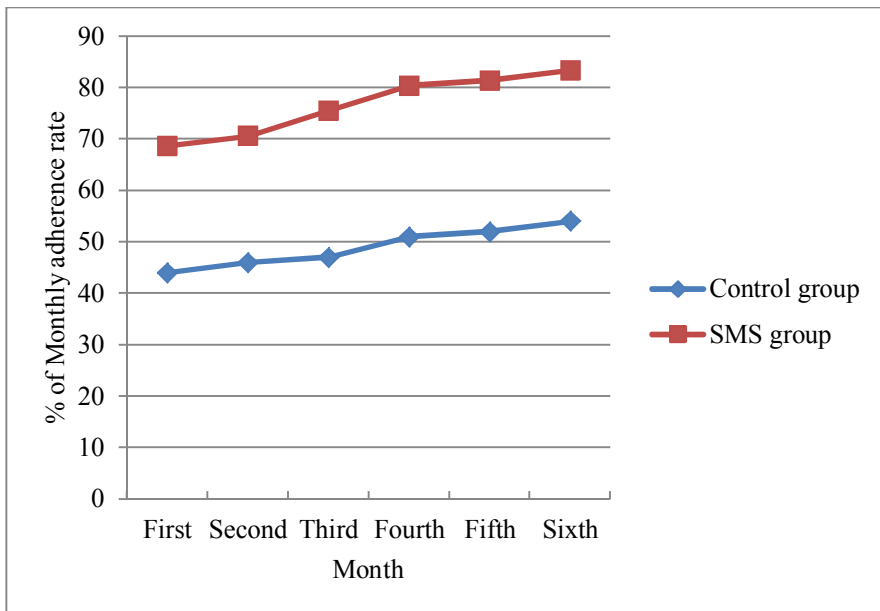


Figure 2. Mean monthly BSE adherence rates of the SMS and control groups.

The monthly adherence rates of the two groups were different from the first month through the end of the study ($P < 0.001$).



DISCUSSION

This study shows that mobile communication technologies can improve BSE adherence. Participants who received text-message reminders were more likely to be adherent to BSE than participants who did not receive text messages. There was no difference in the frequencies of BSE over the six months before participation between the two groups. However, the monthly adherence rates between the two groups started to differ significantly in the first month of enrollment, and this difference continued throughout the study.

Contrary to a previous study that investigated the effect of SMS on adherence to sunscreen application, which showed a decreasing adherence rate in the control group throughout the study, there was a trend towards increasing BSE adherence in both groups during this study. (12, 21) This could be because of characteristics of the participants. All the participants in our study were breast cancer patients who recently underwent surgery for breast cancer and approximately 80% of them received adjuvant treatment such as chemotherapy, radiation therapy or hormonal therapy. During the study, they may have suffered side effects of adjuvant therapy or emotional distress, which may have promoted their

awareness of breast cancer and encouraged them to pursue health-related interventions such as BSE.

To our knowledge, this study is the first randomized controlled trial assessing the ability of a mobile health technology intervention to enhance BSE adherence. (13) Previous studies showed the positive effect of reminders, including phone calls and postcards, on BSE adherence. (11, 12) With these reminders, there was a significant increase in the percentage of women who reported conducting BSE five or more times in the past 6 months (81 vs. 62%, $P < 0.001$). After using a "prompt" which was placed on oral contraceptive pill packages, among the subjects who performed BSE less than once per month before participation, the frequency of BSE increased by 50.9% in the prompt group and by 45.5% in the education-only group.

Although we randomly assigned the patients, there was a significant difference between the two groups in the level of education. However, when educational level was categorized as none (1.0% vs. 1.0%), primary education (5.0% vs. 5.1%), secondary education (37.6% vs. 54.1%) and tertiary education (56.4% vs. 39.8%), there was no significant difference in BSE adherence rates between the reminder and control groups ($n = 199$, $P < 0.075$, Fisher's exact test). Nonetheless, we

included education level for the multivariate analysis because higher education level could be an important factor for BSE adherence. The percentage of participants who reported conducting BSE in the reminder arm of this study was 68.6% at 6 months, which was comparable to compliance rates of other studies.

Screening mammography is the best screening method for breast cancer and 70% of women in the United States now report having had a screening mammogram in the past 2 years. (24, 25) The percentage of breast cancers detected by mammography has also increased from 29% in 1993 to 59% in 2001. However, a large percentage of breast cancers are still detected by the patients themselves. Some researchers, who investigated 361 survivors diagnosed with breast cancer between 1980 and 2003, reported that most breast cancer survivors (57%) reported detection methods other than mammographic examination, including self-examination (25%), accident (18%) and clinical breast examination (13%). Other researchers reported that the rate of self-detected breast cancer is much higher in low-income, underserved populations. (26)

Despite the increase in mammography screening rates, the reasons why the rate of self-detected breast cancer is still high may be because the rate of mammography screening is not high enough to replace other

methods such as BSE or clinical breast examination, or the incidence rate of interval breast cancer is too high to be detected by regular mammography, especially in women younger than 40 who do not get routine mammography. (27) More studies are needed to reveal why many breast cancers continue to be detected by screening methods other than mammography and every effort must be made to improve the quality of screening mammography and enhance the rate of mammography screening. Moreover, under circumstances in which a large percentage of breast cancers are still detected by patients themselves, future research should investigate other methodologies such as BSE and clinical breast examination for detection of breast cancer. (28-30)

The U.S. Preventive Services Task Force (USPSTF) recommends against clinicians teaching women how to perform BSE because adequate evidence suggests that teaching BSE does not reduce breast cancer mortality and is associated with harms such as an increased rate of unnecessary biopsy. (5, 7) For BSE, sensitivity ranges from 12% to 41%, lower than that of mammography. (31) The American Cancer Society states that there is insufficient evidence to recommend BSE.(32) However, teaching BSE is one thing and practicing BSE is another. Despite the fact that every efforts to teach women how to perform BSE have been made, if

there is no change of their behavior patterns in daily life, it is no use of teaching BSE. Up to date, there is no study which investigated whether practicing BSE regularly has an effect to reduce breast cancer mortality and facilitate the detection of interval breast cancer. Our study was focused on changing the behavior patterns of breast cancer survivors with SMS which was proven to be an effective and low-cost method to enhance adherence to BSE.

An important limitation of our study is the possibility of recall and selection bias. When subgroup analysis was performed, a significant difference in the frequency of BSE over the past 6 months was preserved in the recall subgroup but not in the checklist and uncertainty subgroups. In the case of the recall subgroup, patients were asked to recall the dates of BSE over the past 3 months. Thus, recall bias could contribute to the primary outcomes. To reduce the effect of recall bias, we analyzed the monthly adherence rates at the third and sixth months in the recall subgroup and found a significant difference in the SMS intervention group. In the checklist and uncertainty subgroups, there was no significant difference. This could be because of selection bias. The checklist subgroup consisted of participants who brought back the checklists at both 3 and 6 months and these participants might have been more committed to

complete monthly BSE.

The results of this study need to be interpreted in the context of the study design. First, the long-term benefit of this intervention has not yet been demonstrated. This study lasted 6 months and a longer follow-up period would be required to comment on the long-term effects of SMS intervention. Second, this study was a trial of the reminding and completing BSE. We do not know the effect of SMS intervention on finding interval breast cancer or reducing the risk of dying from breast cancer recurrence. Finally, all the participants in our study were breast cancer patients. Thus, the results of the study can only be generalized to this population.

CONCLUSIONS

This study shows the possibility of future integration of mobile communication systems and breast cancer screening methods for public health programs. The short-term results of this trial suggest that SMS reminders are an effective and low-cost method to enhance adherence to BSE using existing information technology infrastructure.

COMPETING INTERESTS

All of the authors declare that they have no conflicts of interest.

REFERENCES

1. Meissner HI, Klabunde CN, Han PK, Benard VB, Breen N. Breast Cancer Screening Beliefs, Recommendations, and Practices. *Cancer*. 2011 Jul;117(14):3101-11. PubMed PMID: WOS:000292537000007.
2. Saslow D, Boetes C, Burke W, Harms S, Leach MO, Lehman CD, et al. American Cancer Society guidelines for breast screening with MRI as an adjunct to mammography. *CA: a cancer journal for clinicians*. 2007 Mar-Apr;57(2):75-89. PubMed PMID: 17392385. Epub 2007/03/30. eng.
3. Warner E. Breast-Cancer Screening. *New England Journal of Medicine*. 2011 Sep;365(11):1025-32. PubMed PMID: WOS:000294857300010.
4. Khatcheressian JL, Wolff AC, Smith TJ, Grunfeld E, Muss HB, Vogel VG, et al. American Society of Clinical Oncology 2006 update of the breast cancer follow-up and management guidelines in the adjuvant setting. *Journal of Clinical Oncology*. 2006 Nov;24(31):5091-7. PubMed PMID: WOS:000241825900021.

5. U.S. Preventive Services Task Force. Screening for Breast Cancer: U.S. Preventive Services Task Force Recommendation Statement. *Annals of Internal Medicine*. 2009;151(10):716-W.236. PubMed PMID: 45306634.
6. Grunfeld E, Dhesy-Thind S, Levine M, Steering Comm Clin Practice G. Clinical practice guidelines for the care and treatment of breast cancer: follow-up after treatment for breast cancer (summary of the 2005 update). *Canadian Medical Association Journal*. 2005 May;172(10):1319-20. PubMed PMID: WOS:000228745000021.
7. Thomas DB, Gao DL, Ray RM, Wang WW, Allison CJ, Chen FL, et al. Randomized trial of breast self-examination in Shanghai: Final results. *Journal of the National Cancer Institute*. 2002 Oct;94(19):1445-57. PubMed PMID: WOS:000178289300011.
8. Hackshaw AK, Paul EA. Breast self-examination and death from breast cancer: a meta-analysis. *British Journal of Cancer*. 2003 Apr;88(7):1047-53. PubMed PMID: WOS:000182663700012.
9. Janz NK, Becker MH, Anderson LA, Marcoux BC. Interventions to enhance breast self-examination practice: a review. *Public health reviews*. 1989;17(2-3):89-163. PubMed PMID: 2491396. Epub 1989/01/01. eng.

10. Pinto B, Fuqua RW. Training breast self-examination: a research review and critique. *Health education quarterly*. 1991 Winter;18(4):495-516. PubMed PMID: 1757270. Epub 1991/01/01. eng.
11. Ferris DG, Golden NH, Petry LJ, Litaker MS, Nackenson M, Woodward LD. Effectiveness of breast self-examination prompts on oral contraceptive packaging. *Journal of Family Practice*. 1996 Jan;42(1):43-8. PubMed PMID: WOS:A1996TP48500004.
12. Strickland CJ, Feigl P, Upchurch C, King DK, Pierce HI, Grevstad PK, et al. Improving breast self-examination compliance: A Southwest Oncology Group randomized trial of three interventions. *Preventive Medicine*. 1997 May-Jun;26(3):320-32. PubMed PMID: WOS:A1997WX73000008.
13. Khokhar A. Short Text Messages (SMS) as a Reminder System for Making Working Women from Delhi Breast Aware. *Asian Pacific Journal of Cancer Prevention*. 2009;10(2):319-21. PubMed PMID: WOS:000270749800026.
14. Krishna S, Boren SA, Balas EA. Healthcare via Cell Phones: A Systematic Review. *Telemedicine Journal and E-Health*. 2009 Apr;15(3):231-40. PubMed PMID: WOS:000265364000005.
15. Lester RT, Ritvo P, Mills EJ, Kariri A, Karanja S, Chung MH, et

- al. Effects of a mobile phone short message service on antiretroviral treatment adherence in Kenya (WeTel Kenya1): a randomised trial. *Lancet*. 2010 Nov-Dec;376(9755):1838-45. PubMed PMID: WOS:000285439700032.
16. Mao YD, Zhang YT, Zhai SD. Mobile phone text messaging for pharmaceutical care in a hospital in China. *Journal of Telemedicine and Telecare*. 2008;14(8):410-4. PubMed PMID: WOS:000262355900003.
17. Fjeldsoe BS, Marshall AL, Miller YD. Behavior Change Interventions Delivered by Mobile Telephone Short-Message Service. *American Journal of Preventive Medicine*. 2009 Feb;36(2):165-73. PubMed PMID: WOS:000262679600012.
18. Wei J, Hollin I, Kachnowski S. A review of the use of mobile phone text messaging in clinical and healthy behaviour interventions. *Journal of Telemedicine and Telecare*. 2011;17(1):41-8. PubMed PMID: WOS:000290119400008.
19. Free C, Knight R, Robertson S, Whittaker R, Edwards P, Zhou W, et al. Smoking cessation support delivered via mobile phone text messaging (txt2stop): a single-blind, randomised trial. *Lancet*. 2011 Jul 2;378(9785):49-55. PubMed PMID: 21722952. Pubmed Central PMCID: PMC3143315. Epub 2011/07/05. eng.

20. Wangberg SC, Arsand E, Andersson N. Diabetes education via mobile text messaging. *Journal of Telemedicine and Telecare*. 2006;12:55-6. PubMed PMID: WOS:000239820300023.
21. Armstrong AW, Watson AJ, Makredes M, Frangos JE, Kimball AB, Kvedar JC. Text-Message Reminders to Improve Sunscreen Use A Randomized, Controlled Trial Using Electronic Monitoring. *Archives of Dermatology*. 2009 Nov;145(11):1230-6. PubMed PMID: WOS:000271889100003.
22. Guerriero C, Cairns J, Roberts I, Rodgers A, Whittaker R, Free C. The cost-effectiveness of smoking cessation support delivered by mobile phone text messaging: Txt2stop. *The European journal of health economics : HEPAC : health economics in prevention and care*. 2012 Sep 9. PubMed PMID: 22961230. Epub 2012/09/11. Eng.
23. Patrick K, Raab F, Adams MA, Dillon L, Zabinski M, Rock CL, et al. A Text Message-Based Intervention for Weight Loss: Randomized Controlled Trial. *Journal of Medical Internet Research*. 2009 Jan-Mar;11(1). PubMed PMID: WOS:000266012600002.
24. Shen Y, Yang Y, Inoue LY, Munsell MF, Miller AB, Berry DA. Role of detection method in predicting breast cancer survival: analysis of randomized screening trials. *J Natl Cancer Inst*. 2005 Aug

- 17;97(16):1195-203. PubMed PMID: 16106024. Epub 2005/08/18. eng.
25. Breen N, Yabroff KR, Meissner HI. What proportion of breast cancers are detected by mammography in the United States? *Cancer detection and prevention*. 2007;31(3):220-4. PubMed PMID: 17573202. Epub 2007/06/19. eng.
26. Thind A, Diamant A, Hoq L, Maly R. Method of detection of breast cancer in low-income women. *Journal of women's health (2002)*. 2009 Nov;18(11):1807-11. PubMed PMID: 19951215. Pubmed Central PMCID: PMC3355470. Epub 2009/12/03. eng.
27. Houssami N, Irwig L, Ciatto S. Radiological surveillance of interval breast cancers in screening programmes. *The lancet oncology*. 2006 Mar;7(3):259-65. PubMed PMID: 16510335. Epub 2006/03/03. eng.
28. Roth MY, Elmore JG, Yi-Frazier JP, Reisch LM, Oster NV, Miglioretti DL. Self-detection remains a key method of breast cancer detection for U.S. women. *Journal of women's health (2002)*. 2011 Aug;20(8):1135-9. PubMed PMID: 21675875. Pubmed Central PMCID: PMC3153870. Epub 2011/06/17. eng.
29. Boulos S, Gadallah M, Neguib S, Essam E, Youssef A, Costa A, et al. Breast screening in the emerging world: high prevalence of breast cancer in Cairo. *Breast (Edinburgh, Scotland)*. 2005 Oct;14(5):340-6.

PubMed PMID: 16131468. Epub 2005/09/01. eng.

30. Pisani P, Parkin DM, Ngelangel C, Esteban D, Gibson L, Munson M, et al. Outcome of screening by clinical examination of the breast in a trial in the Philippines. *International journal of cancer Journal international du cancer*. 2006 Jan 1;118(1):149-54. PubMed PMID: 16049976. Epub 2005/07/29. eng.

31. Goolsby MJ. Clinical practice guidelines. USPSTF recommendations. *Journal of the American Academy of Nurse Practitioners*. 2002 Mar;14(3):100-2. PubMed PMID: 11924331.

32. Smith RA, Cokkinides V, Brawley OW. Cancer screening in the United States, 2009: a review of current American Cancer Society guidelines and issues in cancer screening. *CA: a cancer journal for clinicians*. 2009 Jan-Feb;59(1):27-41. PubMed PMID: 19147867.

초 록

서론: 본 연구는 휴대전화 문자메시지를 이용한 알림 서비스가 유방암환자의 유방자가검진 시행에 미치는 영향을 평가하고자 하였다.

방법: 분당서울대학교병원에서 유방암으로 수술을 받고 휴대전화 단문 메시지 서비스를 사용할 수 있는 20-65세의 여성 환자를 대상으로 무작위배정 대조군 연구를 시행하였다. 참가자는 블록 무작위배정으로 문자메시지군과 대조군으로 나뉘었고 문자메시지군은 매월 1일에 유방자가검진을 알리는 문자메시지와 매월 15일에 유방암에 관한 정보를 제공하는 문자메시지를 받았다. 본 연구에서는 문자메시지군이 대조군보다 유방자가검진 시행률이 높을 것으로 가정하였고, 일차 목표는 유방자가검진 시행률 (6개월간 유방자가검진을 5회 이상 시행한 비율) 과 이차 목표는 6개월간의 유방자가검진 횟수였다.

결과: 2010년 8월부터 2011년 12월까지 216명의 환자를 문자메시지군 (n = 110)과 대조군 (n = 106)에 배정하였고, 202명이 최종 분석에 포함되었다. 문자메시지군에서 유방자가검진 시행률 (자가검진 미시행에 대한 상대위험도 0.49, 95% 신뢰구간 0.36 - 0.67; $P < 0.001$)과 6개월간의 유방자가검진 횟

수 (평균차 1.66, 95% 신뢰구간 1.03 - 2.29; $P < 0.001$)가 통계적으로 유의하게 높았다. 이분형 로지스틱 회귀분석에서 문자메시지가 유방자가검진 시행률을 유의하게 높이는 유일한 요인이었다. (교차비 [OR] 4.08, 95% 신뢰구간 2.24 - 7.43; $P < 0.001$)

결론: 휴대전화 문자메시지를 이용한 알림 서비스는 유방암 환자의 유방자가검진 시행을 높이는 효과적인 수단이다.

임상연구등록: 임상연구정보서비스, KCT0000018

주요어: 유방암, 무작위배정 대조군 연구, 유방자가검진, 단문 메시지 서비스

학 번: 2010-23702

ACKNOWLEDGMENTS

The present research has been supported by the Korea Breast Cancer Foundation.