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The effect of medical drug reminder mobile application on treatment compliance in women with breast cancer under adjuvant hormone treatment

Adjuvan hormon tedavisi gören meme kanserli kadınlarda, ilaç hatırlatma mobil uygulamasının tedaviye uyum üzerine etkisi

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Abstract

Purpose: This study was planned to investigate the effects of a nurse-led medication reminder mobile application on treatment adherence in women with breast cancer receiving adjuvant hormone therapy.

Materials and methods: The research was planned as a prospective quasi-experimental study with pretest, posttest, and control groups, in which the simple randomization method was employed. It consisted of 52 women with breast cancer receiving adjuvant hormone therapy, including 26 in the experimental group and 26 in the control group. The medication reminder mobile application developed by the researchers was utilized in the experimental group to determine its effect on treatment adherence. Data collection measures included a personal information form and the Medication Adherence Self-Efficacy Scale (MASES). After the baseline data of the experimental and control groups were collected, the experimental group used the "Medication Reminder" mobile application for eight weeks. At the end of the eight weeks, the MASES was applied to both groups again.

Results: A statistically significant difference was found between the pre-test and post-test MASES total scores of the experimental group (p<0.05). The post-test MASES total scores of the experimental group were significantly higher than their pre-test scores. The inter-group comparisons indicated that the post-test MASES total scores of the experimental group were statistically significantly higher than those of the control group (p<0.05).

Conclusion: It was concluded that the "Medication Reminder" mobile application was an effective tool in increasing treatment adherence in women with breast cancer under adjuvant hormone therapy.

Keywords: Adjuvant hormone therapy, breast cancer, medication adherence, mobile application, women.

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Öz

Amaç: Bu araştırma, adjuvan hormon tedavisi almakta olan meme kanseri kadınlarda, hemşire öncülüğünde hazırlanmış ilaç hatırlatma mobil uygulamasının tedaviye uyum üzerine etkisinin incelenmesi amacıyla planlanmıştır.

Gereç ve yöntemler: Bu araştırma ön test-son test kontrol gruplu, prospektif, basit randomizasyon yöntemi kullanılan, yarı deneysel bir çalışma olarak planlanmış olup, 26 deney ve 26 kontrol grubu olmak üzere toplam 52 adjuvan hormon tedavisi gören meme kanserli kadın ile yürütülmüştür. Araştırmacılar tarafından geliştirilen ilaç alarmı mobil uygulaması deney grubuna tedaviye uyum üzerine etkisini belirlemek amacıyla uygulanmıştır. Verilerin toplanmasında Kişisel Bilgi Formu ve İlaç Tedavisine Bağlılık/Uyum Öz-Etkililik Ölçeği (MASES) kullanılmıştır. Deney ve kontrol grubunun ilk verilerinin toplanmasının ardından deney grubu 8 hafta süre ile "İlaç Alarmı" mobil uygulamasını kullanmıştır. 8 haftalık sürecin sonunda her iki gruba tekrar MASES uygulanmıştır.

Bulgular: Deney grubundakilerin ön test – son test MASES toplam puanları arasında istatistiksel olarak anlamlı farklılık saptanmıştır (p<0,05). Deney grubunun son test MASES toplam puanları ön teste göre anlamlı derecede daha yüksek olduğu tespit edilmiştir. Gruplar arasında ise son test MASES toplam puanları açısından deney grubunun son test toplam puanları istatistiksel olarak anlamlı derece yüksek olduğu saptanmıştır (p<0,05).

Sonuç: Adjuvan hormon tedavisi alan meme kanserli hastalarda "İlaç Alarmı" mobil uygulamasının tedaviye uyumu arttırma konusunda etkili bir araç olduğu sonucuna ulaşılmıştır.

Anahtar kelimeler: Adjuvan hormon tedavisi, ilaç uyumu, meme kanseri, mobil uygulama, kadın.

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Introduction

Cancer is among the leading causes of mortality worldwide [1]. Breast cancer (BC) ranks first globally among cancer types in women, with the prevalence being 30.3% as shown by Globocan 2020 data [2]. A woman's lifetime likelihood of receiving a breast cancer diagnosis is 1 in 8. Hormone-receptor-positive (HR+) tumors are observed in >80% of the cases [3].

Adjuvant hormone treatments (AHT), such as tamoxifen and aromatase inhibitors (AI), have proven clinical benefits in reducing the risk for BC recurrence when taken for five to ten years for women with estrogen-receptor-positive (ER+) BC [4, 5]. Despite all known positive effects of AHTs in the clinical course, there is current evidence that AHT adherence problems occur. In a descriptive study that was conducted to investigate factors associated with non-adherence to AHT following breast cancer but was not intended to support women, develop interventions to promote their adherence, and inform them, Brett et al. [6] found that of those prescribed AHT, approximately 20% within two years and 50% within five years discontinued treatment.

Poor adaptation and lack of AHT adherence are linked to a higher risk of death. McCowan et al. [7] did a retrospective cohort research in the Tayside area of Scotland to investigate whether women with breast cancer used tamoxifen following breast cancer surgery and whether adherence affected survival, and found the mean duration of use as 2.42 years. The mortality rate over the 2.4-year period was 0.85. The mean adherence to tamoxifen was calculated as 93%. Adherence of less than 80% was associated with poorer survival and a mortality rate of 1.10. Only 49% of those who had a moderate level of tamoxifen adherence and were followed for 5 years or longer continued it for five years. Extending the time of tamoxifen use lowers mortality risk, but half of the women fail to fulfill the suggested five-year-long treatment. A significant proportion of women exhibit poor tamoxifen adherence and face higher mortality risk [7].

Many factors affect treatment adherence. Type of AHT drugs used, adverse effects experienced during treatment, early age/advanced age, cost of treatment, history of changing AHT type, being married, having undergone mastectomy/lumpectomy, presence of comorbidities, negative beliefs about the effectiveness of treatment, and receiving chemotherapy or radiotherapy are among the factors that affect treatment adherence [8-10]. Conditions linked to non-compliance should be named and new ways of promoting and sustaining compliance with AHT should be discovered. With the development of technology, the use of mobile applications in the health field is growing [11]. Technology-based interventions can be used as a new way of enhancing AHT non-compliance. The number of smartphone users has grown lately, which has offered an opportunity to utilize these devices to practice evidence-supported healthcare interventions [12, 13].

Mobile health applications are used in many areas, such as the management of an individual's health status (hospital appointment system, treatment adherence, etc.), monitoring of health status (patient monitoring devices, etc.), and keeping health records. Mobile health approaches that are easy to use, allow free access, provide symptom management, make recommendations on symptom management, and support communication with healthcare professionals are preferred by patients [14, 15].

There are many mobile applications developed for cancer treatment. Patients and healthcare staff can benefit from them. They have a critical role in the management of cancer treatment, i.e., handling adversities, backing up medication adherence, organizing and monitoring cancer treatment, offering information about cancer, and spotting and diagnosing disorders [16]. Mobile applications designed for women with breast cancer have positive effects in promoting patient health and have been shown to be used as an information source. They can also be utilized to manage disease and treatment-related symptoms, report treatment-related adverse events, and promote self-care [17].

Thakkar et al. [13] carried out a meta-analysis and found that 15 mobile-based messaging apps nearly multiplied the likelihood of medication compliance among patients with chronic diseases. A descriptive study by Ali et al. [18] showed that 66% of participants showed attention to the mobile application used in the study for AHT compliance and that the entirety of them were interested in its content. However, further research is needed to examine possible changes over time in social backing, AHT adherence and symptoms experienced, quality of life related to health, and further elements impacting AHT compliance [18].

The impact of a nurse-led medication reminder mobile application on treatment adherence in women with BC on adjuvant hormone therapy was studied in this research.

H_1=A mobile application that supports treatment adherence will affect the adherence in the short term in women with BC on adjuvant hormone therapy.

Materials and methods

Type of research

This research was planned as a prospective quasi-experimental study with pre-test, post-test, and control groups, in which the simple randomization method was used. Patients who had breast cancer and were on adjuvant hormone therapy were randomized to experimental and control groups.

Population and sample

Data were collected from women who presented to the Medical Oncology Unit of the Dışkapı Yıldırım Beyazıt Training and Research Hospital of the Health Sciences University, Ministry of Health, the Republic of Türkiye between September 2021 and November 2022, were diagnosed with breast cancer, and continued adjuvant hormone therapy at home. Sample size estimation was done with a power analysis by utilizing the data of a study conducted using the Medication Adherence Self-Efficacy Scale (MASES) to evaluate medication adherence and self-efficacy in cancer patients who had previously used oral chemotherapy drugs [19]. Accordingly, the sample size was estimated as 36 individuals, a minimum of 18 subjects per group (power: 90%; confidence interval: 95%; d=1.0; α=0.05). Considering that there might be some attrition and parametric tests could be used, it was decided to include 60 individuals in the study, 30 in each group. Eight patients with no regular attendance were excluded, with the eventual sample size being 52. The inclusion criteria for the participants in the study were being aged 18 and over, having been diagnosed with hormone receptor-positive breast cancer (stages 0-III), receiving adjuvant hormone therapy, having a smartphone, agreeing to use a mobile application on the smartphone for 2 months, and speaking Turkish for the experimental group. The control group consisted of participants aged 18 and over, having been diagnosed with hormone receptor-positive breast cancer (stages 0-III), receiving adjuvant hormone therapy, and speaking Turkish.

Randomization

Since it was planned to have an equal number of participants in the experimental and control groups in this study, the “simple randomization method” was employed. Patients who met the inclusion criteria for participation in the study were randomly assigned to the experimental (30 subjects) and control groups (30 subjects) according to their registration number given at the time of admission by numbering them from 1 to 60 and starting from the last admission. The randomization process was carried out on the https://www.randomizer.org/ website.

Measures

Face-to-face and telephone interviews were held to gather data. A three-section and 21-item form that the researcher designed was utilized to gather socio-demographic data from women with BC who volunteered to participate in the study, information about their disease and treatment process, and their technology use [20-22]. Dependent variables were measured with the Medication Adherence Self-Efficacy Scale (MASES), which Gözüm and Hacıhasanoğlu [23] adapted into Turkish. The scale was modified in a thesis study that was conducted by Tokdemir [24] and in which oral chemotherapy medication adherence used by cancer patients was evaluated. Nine experts (three specialist nurses in the fields of Nursing, Hematology, and Oncology, five faculty members, and one clinical nurse) were consulted in the process [24]. Since

the sample of our study included subjects with BC receiving AHT, the version of the MASES scale modified by Tokdemir [24] was preferred. The necessary permission was obtained from the author via e-mail to use the scale in our research. An eight-week intervention was planned to evaluate adherence in the short term as the study was conducted within the scope of a thesis process and a previous study by Graetz et al. [20] was taken as a reference.

This study was approved by the Pamukkale University Non-Interventional Clinical Ethics Committee (approved date: 02.02.2021 and approved number: 60116787-020/14394; issue: 03). Written permission was obtained from the Dışkapı Yıldırım Beyazıt Training and Research Hospital, Health Sciences University, Republic of Türkiye.

Design and implementation process of the mobile application

The design process of the medication reminder mobile application for women with BC on AHT was completed in four stages.

Stage 1: At this stage, studies on treatment adherence in women with BC receiving AHT, factors affecting adherence, problems with adherence, mobile applications supporting treatment adherence, and software development costs were examined.

After the design process of the mobile application was completed, a contract was drawn up with a company that met the design criteria by receiving financial support from the Pamukkale University Scientific Research Project (project number 2021SABE011). The mobile application provided access to the system by creating a username and password.

Stage 2: At this stage, the logo and design plans of the mobile application were handled by the researchers. Pink and white colors symbolizing breast cancer were taken as the basis for the user interface and general design of the application. The logo (Figure 1) and interface (Figure 2) of the mobile application are shown below.

Stage 3: The mobile application was tested at this stage. It was tested first by the researchers and then by five women with BC receiving AHT. Errors were detected and necessary modifications were made.

Stage 4: After the technical problems of the application were resolved, some changes considered by the researchers were made in the application, and it was finalized.

Participants registered in the system by the admin could log in to the application with their usernames and passwords. After logging in to the application, the person's name appeared on the screen. The names of the drugs used by the participant and their times and doses were entered into the system by the admin. The purpose of the application, a calendar, a medication prescription page, and user information were included in the interface content.

Figure 1. "MedicationReminder" mobile application logo

Figure 2. "Medication Reminder" mobile application interface

The application automatically sent a notification reading "medication time" with the user's name and the name of the drug to be taken at the time specified by the participant. Then, another message reading, "Hello, have you taken your medication?" was automatically sent to the user as a reminder an hour later. Patients could confirm this notification by responding "yes" or "no."

Experimental group

The researcher contacted patients who volunteered to participate in the study via phone, and the purpose of use and instructions for the "Medication Reminder" mobile application were explained. Afterward, participants were informed about how to download the mobile application from the virtual market and were requested to download it. A personal username and password were created for the participant who downloaded the mobile application via the admin page. The identification of the user who logged into the application was checked through the system, and the medication used by the patient and the time of use were defined for each patient. Then, the "Personal Information Form" and the "Medication Adherence Self-Efficacy Scale (MASES)" were filled in by the researcher via phone calls.

After the interview was completed, the participants started using the application. At the time specified by the participant, a reminder reading "It's time for medication" was automatically sent to the participant with the username and the name of the medication used. Then, an hour later, another reminder reading "Hello, have you taken your medication?" with the name of the medication was automatically sent to the participant. Patients answered this reminder with a "yes" or "no" response. At the end of the eight weeks, the "Medication Adherence Self-Efficacy Scale (MASES)" was re-administered via phone calls. Participants were requested not to use an additional reminder method during this period.

Control group

The control group participants were contacted via phone, and the "Personal Information Form" and the "Medication Adherence Self-Efficacy Scale (MASES)" were administered. No intervention was applied to the control group participants. The "Medication Adherence Self-Efficacy Scale (MASES)" was re-administered eight weeks after the first application. After the data collection phase, the control group participants were also allowed to use the mobile application.

Statistical analysis

Data were evaluated on the SPSS software. The 'Shapiro-Wilk test' was used to test the normality of the variables. As the data had no normal distribution, the Mann-Whitney U test (Z-table values) was used to compare the measurement values of two independent groups. The Wilcoxon test (Z-table values) was utilized to compare the measurement values of two dependent groups. In data with normal distribution, the independent samples t-test (t-table values) was used to compare the measurement values of two independent groups. Pearson-χ2 cross tables were employed to examine the relationships between two qualitative variables. Statistical significance was specified as $p<0.05$*.

Results

In the experimental group, the mean age was 46.03, with the standard deviation being 8.63, and varying between 33 and 59, 17 (56.7%) were high school graduates, 19 (63.3%) were married, 21 (70.0%) had an equal income and expenses, and 14 (46.7%) had no jobs. In the control group, the mean age was 47.63, the standard deviation was 7.24, varying between 30 and 58, 18 of the subjects (60.0%) had high school education, 16 (53.3%) were married, 20 (66.7%) had equal income and expenses, and 16 (53.3%) were unemployed. The group had no statistically meaningful association with education ($p=0.803$), age (years) ($p=0.137$), marital status ($p=0.728$), employment ($p=0.796$), and income ($p=0.836$). Table 1 presents participants' socio-demographic data.

Table 1. Comparison between sociodemographic variables and groups (n:60)

Variables	Experimental (n:30)		Control (n:30)		Statistical Analysis*
	n	%	n	%	Probability
Education					
Primary school	7	23.3	5	16.7	
High school	17	56.7	18	60.0	$X^2=0.439$ $p=0.803$
Undergraduate	6	20.0	7	23.3	
Marital status					
Married	19	63.3	16	53.3	
Single	5	16.7	6	20.0	$X^2=0.634$ $p=0.728$
Divorced/widowed	6	20.0	8	26.7	
Income					
Income<expenses	8	26.7	8	26.6	
Income=expenses	21	70.0	30	66.7	$X^2=0.353$ $p=0.836$
Income>expenses	1	3.3	2	6.7	
Employment status					
Yes	16	53.3	14	46.3	$X^2=0.067$ $p=0.796$
No	14	46.7	16	53.3	
	x̄ ± S.D.	**Median (Min.- Max.)**	**x̄ ± S.D.**	**Median (Min.- Max.)**	
Age (year)	46.03±8.63	45.0 (33.0-59.0)	47.63±7.24	50.0 (40.0-58.0)	$Z=1.488$ $p=0.137$

"Pearson-X^2" cross tables were used to examine the relationships between two qualitative variables. In data that did not have a normal distribution, "Mann-Whitney U" test (Z-table values) was used to compare the measurement values of two independent groups

Sixteen individuals (53.3%) in the experimental group had stage 1 disease, 26 (86.7%) had the disease for 7-23 months, 19 (63.3%) used tamoxifen, 16 (53.3%) had a planned treatment of 5-10 years, 14 (77.8%) received concurrent radiotherapy treatment, and 19 (34.6%) had received chemotherapy before AHT. Of the participants in the control group, 14 (46.7%) had stage 2 disease, 23 (76.7%) had the disease for 7-23 months, 13 (43.3%) used tamoxifen, 19 (63.3%) had a planned treatment for 5-10 years, 18 (82.4%) received concurrent radiotherapy treatment, and 26 (44.1%) had received chemotherapy before AHT. It was determined that 23 people (76.7%) in the experimental group had received information about the drugs they used, 23 (63.9%) said that the person who provided drug information was a physician, and that 15 (76.7%) found the information adequate. It was determined that 18 people (60.0%) in this group thought that cancer would not recur if the drugs were used regularly. Of the participants in the control group, 21 (70.0%) had received information about the drug they used, 21 (63.6%) stated that the person who provided information about the drugs was a physician, and 10 (47.6%) thought that the information they received was adequate. Seventeen participants (56.7%) in this group thought that cancer would not recur with regular use of drugs. The group did not have a statistically meaningful association with stage of disease (p=0.102), length of treatment (month) (p=0.092), duration of disease (p=0.453), drugs used (p=0.190), planned treatment time (p=0.517), status of receiving concurrent treatment (p=0.752), treatments received before AHT (p=0.256), status of receiving information about the drugs used (p=0.559), person giving information about the drugs (p=0.625), adequacy of the information (p=0.083), and belief that cancer would not recur with regular use of the drugs (p=0.965). Information about the disease and treatment process of the participants is shown in Table 2.

Table 2. Comparisons between the groups and information regarding the disease and treatment process (n:60)

Variables	Experimental (n:30)		Control (n:30)		Statistical Analysis*
	n	%	n	%	Probability
Stage of disease					
Stage 0	2	6.7	2	6.7	
Stage I	16	53.3	7	23.3	X^2=6.209 p=0.102
Stage II	9	30.0	14	46.7	
Stage III	3	10.0	7	23.3	
Length of disease					
0-6 months	4	13.3	6	20.0	
7- 23 months	26	86.7	23	76.7	X^2=1.584 p=0.453
2- 5 years	-	-	1	3.3	
Drugs used					
Tamoxifen	19	63.3	13	43.3	
Letrozole	9	30.0	11	46.7	X^2=3.325 p=0.190
Anastrozole	2	6.7	6	20.0	
Planned treatment time					
Unknown	1	3.4	2	6.7	
3-5 years	13	43.3	9	30.0	X^2=1.318 p=0.517
5-10 years	16	53.3	19	63.3	

Table 2. Comparisons between the groups and information regarding the disease and treatment process (n:60) (continued)

Variables	Experimental (n:30)		Control (n:30)		Statistical Analysis*
	n	%	n	%	Probability
Concurrent treatment**					
Chemotherapy	4	22.2	4	17.6	X^2=0.101 *p*=0.752
Radiotherapy	14	77.8	18	82.4	
Treatments before AHT **					
Chemotherapy	19	34.4	26	44.1	
Radiotherapy	7	12.7	3	5.1	X^2=4.052 *p*=0.256
Mastectomy	18	32.7	23	39.0	
Lumpectomy	11	20.0	7	11.8	
Receiving information about the drugs used					
Yes	23	76.7	21	70.0	X^2=0.341 *p*=0.559
No	7	23.3	9	20.0	
Source of the drug information*					
Physician	23	63.9	21	63.6	
Nurse	3	8.3	2	6.1	
Other patients	1	2.8	4	12.1	X^2=2.608 *p*=0.625
Pharmacy	4	11.1	3	9.1	
Book/the Internet	5	13.9	3	9.1	
Adequacy of the information					
Yes	15	65.2	10	47.6	
No	-	-	4	19.0	X^2=4.986 *p*=0.083
Undecided	8	34.8	7	33.3	
The belief that cancer will not recur with regular use of the drugs					
Yes	18	60.0	17	56.7	
No	1	3.3	1	3.3	X^2=0.072 *p*=0.965
Undecided	11	36.7	12	40.0	
	x̄ ± S.D.	**Median (Min.- Max.)**	**x̄ ± S.D.**	**Median (Min.- Max.)**	
Length of treatment (mont)	5.60±2.81	5.5 (1.0-12.0)	4.47±2.50	4.0 (1.0-12.0)	Z=1.687 *p*=0.0.92

"Pearson-X^2" cross tables were used to examine the relationships between two qualitative variables. In non-normally distributed data, "Mann-Whitney U" test (Z-table values) was used to compare the measurement values of two independent groups.
More than one answer was given to the question and percentages were calculated according to the increasing number of cases

It was determined that 30 participants (26.5%) in the experimental group used their mobile phones for communication, 14 (46.7%) had a moderate level of technology use skills, and that 17 (56.7%) used Android-based phones. Of the participants in the control group, 30 (25.5%) used their mobile phones for communication, 13 (43.3%) had a good level of technology use skills, and 16 (53.3%) used Android-based phones. The group had no statistically marked association with daily screen time (hours) (*p*=0.185), the purpose of mobile phone use (*p*=0.703), the model used (*p*=0.185), duration of smartphone use (years) (*p*=0.122), technology use skills (*p*=0.252). Table 3 reflects subjects' technology use features.

Table 3. Comparisons between technology use characteristics and groups (n:60)

Variables	Experimental (n:30)		Control (n:30)		Statistical Analysis*
	n	%	n	%	Probability
Purpose of using a mobile phone**					
Communication	30	26.5	30	25.4	X^2=3.803 *p*=0.703
Messaging	28	24.8	29	24.6	
Taking photographs	11	9.7	15	12.6	
Games	15	13.3	12	10.2	
Music	1	0.9	4	3.4	
The İnternet	16	14.2	12	10.2	
Social media	12	10.6	16	13.6	
Technology use skills					
Very good	3	10.0	6	20.0	X^2=4.087 *p*=0.252
Good	13	43.3	13	43.3	
Moderate	14	46.7	9	30.0	
Poor	-	-	2	6.7	
The model of the device					
IPhone	13	43.3	14	46.7	X^2=0.067 *p*=0.185
Android-based phones	17	56.7	16	53.3	
	x̄ ± S.D.	**Median (Min.- Max.)**	**x̄ ± S.D.**	**Median (Min.- Max.)**	
How long the person had the phone (year)	7.20±2.39	7.0 (4.0-15.0)	6.20±1.27	6.0 (4.0-9.0)	Z=-1.546 *p*=0.122
Daily screen time (hour)	3.07±1.8	3.0 (1.0-6.0)	2.60±0.97	2.5 (1.0-5.)	Z=-1.326 *p*=0.185

"Pearson-X^2" cross tables were used to examine the relationships between two qualitative variables. In non-normally distributed data, "Mann-Whitney U" test (Z-table values) was used to compare the measurement values of two independent groups.
More than one answer was given to the question and percentages were determined according to the increasing number of cases

The pre-test MASES total scores did not yield statistically meaningful variances between the groups (*p*=0.054). Table 4 displays a summary of scores on the pre-test.

According to an inter-group comparison, post-test total MASES scores yielded a statistically meaningful variance with the experimental group having markedly higher scores (*p*=0.002*). Table 5 presents the post-test MASES total scores of both groups.

An intra-group comparison indicated that the pre-and post-test scores of the experimental group on the MASES differed statistically meaningfully with scores obtained from the post-test application being markedly higher (*p*=0.001*). A similar comparison yielded no variance for the control group (*p*=0.113). Tables 6 and 7 display total MASES figures from the pre-and post-test applications for the groups, respectively.

Table 4. Inter-group comparison of pre-test MASES total scores (n:60)

Variable	Experimental (n:30)		Control (n:30)		Statistical Analysis*
	x̄ ± S.D.	Median (Min.- Max.)	x̄ ± S.D.	Median (Min.- Max.)	Probability
MASES total score					
Pre-test	59.83±5.99	60.5 (48.0-71.0)	56.30±7.82	57.0 (42.0-67.0)	t=1.964 *p*=0.054

In data with normal distribution, the independent samples t-test (t-table values) was used to compare the measurement values of two independent groups

Table 5. Comparison of post-test MASES total scores by groups (n:52)

Variable	Experimental (n:30)		Control (n:30)		Statistical Analysis*
	x̄ ± S.D.	Median (Min.- Max.)	x̄ ± S.D.	Median (Min.- Max.)	Probability
MASES total score					
Pre-test	62.07±4.68	62.5 (54.0-72.0)	56.0±6.96	54.5 (44.0-67.0)	Z=-3.171 **p*=0.002

In data with no normal distribution, the "Mann-Whitney U" test (Z-table values) was used to compare the measurement values of two independent groups, **p*<0.05 statisticallysignificant

Table 6. Comparison of the pre-test-post-test MASES total scores of the experimental group (n:26)

Variables	Experimental (n:26)	
	x̄ ± S.D.	Median (Min.- Max.)
MASES total score		
Pre-test	60.88±5.51	60.0 (50.0-71.0)
Post-test	62.07±4.68	62.5 (54.0-72.0)
Analysis Probability	Z=-3.379 **p*=0.001	

In data with no normal distribution, the "Wilcoxon" test (Z-table values) was used to compare two dependent groups, **p*<0.05 statisticallysignificant

Table 7. Comparison of the pre-test-post-test MASES total scores of the control group (n:26)

Variables	Control (n:26)	
	x̄ ± S.D.	Median (Min.- Max.)
MASES total score		
Pre-test	55.23±7.79	55.5 (42.0-67.0)
Post-test	56.00±6.96	54.5 (44.0-67.0)
Analysis Probability	Z=-1.586 *p*=0.113	

In data with no normal distribution, the "Wilcoxon" test (Z-table values) was used to compare two dependent groups

Discussion

There are many descriptive and qualitative studies in the literature into the factors affecting treatment adherence [8-10, 25-32]. As the rate and frequency of mobile phone use have increased in recent years, their use in healthcare services has also increased [12]. However, there is little research into the evidence-based effectiveness of mobile applications that include personalized, treatment-specific medication reminder goals [12, 27]. Our study is thought to make a significant contribution to the literature because it includes the evaluation of the evidence-based effectiveness of the "Medication Reminder" mobile application.

Graetz et al. [20] designed a RCT (a pilot study) to investigate application use one with and the other without a weekly reminder that supported treatment-related side effects and aromatase inhibitor use to reduce symptom burden and improve medication treatment adherence. The researchers compared the BApp+ reminder group in terms of using the application to report aromatase inhibitor adherence and symptoms (via text messages and/or email, as preferred) and the BApp group accessing the application but with no reminders delivered monthly. After the AHT, groups were followed for the first 6-8 weeks. The web-based mobile application with weekly reminders for AI adherence and real-time reporting of treatment-related adverse symptoms was reported to be feasible and effective for improving short-term AI adherence among women with HR+ breast cancer [20]. The study conducted by Graetz et al. [20], despite having a different design, aimed to remind people to take their medications. It is possible to say that the web-based intervention with a medication reminder feature had a positive effect on aromatase inhibitor treatment adherence in the short term, which was consistent with our study.

In a pilot study of 2019, Krok Schoen et al. [21] examined the effects of a text-based intervention application on treatment adherence in women receiving breast cancer treatment in the postmenopausal period. Text messages were delivered to participants' phones as a reminder for AHT medications every day, which continued for ninety days. The study results showed that the application not only supported adherence to AHT but also improved the well-being parameters of the patients. The levels of stress perceived fell markedly throughout the study. Self-report data and blood samples revealed that participants had AHT medication adherence. In the study conducted by Krok Schoen et al. [21], there was no randomization and no control group, and only the pre-test and post-test scores of the experimental group were compared. The study had a different intervention as a study design but addressed a goal and produced results similar to those of our study.

In a prospective randomized controlled study, Tan and colleagues [33] looked into how SMS reminders impacted medication adherence and serum hormone levels in patients with BC taking aromatase inhibitors. They compared SMS reminders with standard care. SMS reminders were sent to all patients participating in the study at the same time on a predetermined day and time weekly. Medication adherence was assessed with the Simplified Medication Adherence Questionnaire (SMAQ) in the sixth and twelfth months. According to the research by Tan et al. [33], the group receiving SMS reminders showed significant adherence compared to the group receiving standard care in the sixth month, with the inter-group variance being unmeaningful in the twelfth month. The inter-group comparison of serum hormone levels indicated no marked variance in the twelfth month. It was concluded that weekly SMS reminders improved medication adherence in the short term, but it had no effect on serum hormone levels in the long run [33]. The data from this study showed that the medication reminder intervention with daily text messages increased treatment adherence in the short term, consistent with the present research. The main distinction was that reminders were sent once a week on a day and time determined by the researchers.

In another randomized controlled study conducted by Hershman et al. [34] to determine whether a one-way SMS reminder could improve long-term adherence, patients received a text message twice a week, one on a randomly selected day during the week and another on a randomly selected day during the weekend, for three years. According to the data of the study,

the one-way text messaging intervention twice a week did not significantly affect AI adherence in women with BC. The study conducted by Hershman et al. [34] did not obtain a result similar to ours because the effects of a one-way text message reminder on long-term treatment adherence had been examined, and another distinction was that the frequency of reminders was twice a week, while it was every day in our study.

When other studies producing results similar to our research were examined [20, 21, 33, 34], it can be said that the scale used in our study was a short, intelligible, and effective tool in assessing treatment adherence in the short term. According to the research data, the medication reminder mobile application was an efficient tool in increasing treatment adherence in the short term in women with BC on AHT.

In conclusion, it was found that the medication reminder mobile application, which aimed to improve treatment adherence in patients with BC under AHT, offered an alternative to technological developments, was an evidence-based and effective method, and came up with a new approach that supported patients' treatment adherence. In future studies, longer-term follow-up of mobile medication reminder applications and evaluation of their results will reveal the importance of mobile applications such as "Medication Reminder," which is a personalized, treatment-specific smartphone application.

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