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Original Article

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Effect of Automated Text Messages and Virtual Education on Self-Care Behaviors Among Heart Failure Patients After Surgery

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Abstract

Introduction: Considering the rising number of patients with heart failure, their growing care needs, and the effectiveness of both the automatic text message reminder system and virtual space, this study aimed to compare the effect of patient education using an automatic text message reminder system versus virtual space (via Soroush Messenger) on the self-care behaviors of patients with heart failure.

Methods: This quasi-experimental study included 60 patients with a history of surgery and heart failure. Sampling was performed randomly, and patients were divided into three groups: intervention 1 (text message reminder), intervention 2 (virtual space), and control. The research instruments included a demographic characteristics questionnaire and the European Heart Failure Self-Care Behavior Scale. In the intervention groups, daily text message reminders and self-care educational messages were sent for one month. The scale was completed by all participants in both the virtual education and automated text message groups before and after the intervention. Paired t-tests, and analysis of variance were employed and the data were analyzed using SPSS software (version 26).

Results: A total of 60 patients participated in the study, with a mean age of 54.87 ± 16.25 years; 66.6% (n = 40) were male, and 91.6% (n = 55) were married. Most participants (98.3%) (n = 59) were of Baluch ethnicity. Baseline characteristics were comparable among the control, automatic text message reminder system, and the Soroush Messenger groups ($P > 0.05$). After the intervention, both the automatic text message reminder system and Soroush Messenger groups showed significant improvements in self-care behavior scores compared to the baseline ($P < 0.01$), while no significant change was observed in the control group ($P > 0.05$).

Conclusions: Education via reminder text messages and education via the virtual space (Soroush Messenger) had similar effects on improving the self-care behaviors of patients with heart failure. Therefore, given their simplicity, low cost, and accessibility, these methods are recommended for patient education across various fields.

Key words: Education, Heart failure, Self-efficacy, Text messaging, Virtual reality

Introduction

Heart failure is considered one of the most common chronic diseases and a significant public health problem, associated with high mortality rates, poor quality of life, and frequent hospital admissions (1). It is recognized as one of the most prevalent chronic diseases in developed countries (2). Recent epidemiological studies in Iran indicate that approximately 1% of individuals aged > 40 years are affected by heart failure. The prevalence of this condition exhibits a marked age-related increase, doubling with each passing decade and reaching nearly 10% among those aged > 70 years (3).

Although significant advancements in the

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treatment of patients with cardiac disease have occurred over the last two decades, the prevalence of heart failure is on the rise. The American Heart Association reports that approximately 3.7% of all cardiovascular disease-related deaths are attributed to heart failure (4). Substantial evidence indicates that individuals with heart failure face numerous physical, psychological, emotional, and spiritual consequences. Furthermore, family members who provide care also encounter significant challenges (5). Collectively, these symptoms culminate in limitations in daily activities and the ability to perform personal and social affairs (6).

Given the high rate of hospital admissions and readmissions for heart failure (7), this disease imposes a significant financial burden on patients and healthcare systems (8). In Iran, the annual cost of this disease is estimated at 400 billion Rials, which should serve as a warning to develop preventive strategies to achieve greater efficiency at lower cost. A critical point is that there is limited awareness regarding the factors that lead to readmission after the discharge of patients with congestive heart failure. Therefore, finding methods to control heart failure and its complications, such as readmission, is of particular importance. Self-care is one such method (9). Self-care among patients with heart failure refers to a set of intentional health behaviors aimed at maintaining physiological stability and managing symptoms, including adherence to medication, sodium and fluid restriction, daily weight monitoring, symptom observation, and regular physical activity (10). Studies have shown that at least 50% of patients with heart failure do not adhere to their therapeutic recommendations, leading to readmission (11). Self-care in heart failure involves aspects, such as diet and medication management, sodium and fluid intake restriction, regular exercise, symptom monitoring, disease exacerbation signs, and the search for and decision-making regarding appropriate therapeutic actions. Self-care leads to improved patient general health, active participation in the care process, enhanced quality of life, and, ultimately, reduced treatment costs (12). Various methods of follow-up care exist, including in-person visits to healthcare centers or home visits by a nurse, both of which require significant human resources, high cost, and substantial time (13). Therefore, more effective and cost-efficient methods should be considered. Mobile Health (mHealth) is one such method that removes temporal and geographical barriers and is highly cost-effective, drawing significant attention today (14).

Mobile phones and text messaging are now part of people's daily lives and are powerful tools for improving health, warning about disease risks, and aiding disease prevention (15). The rate of mobile phone ownership has rapidly increased from 6.6% in 2010 to 64.2% (approximately 7 billion) in 2014 (16). Results from several studies have demonstrated the effectiveness of self-care education and adherence to the therapeutic regimen for patients and families via mobile phones and text messages (17-22). A study by Chen et al. showed that text messaging can improve self-care behaviors among patients with heart failure (23). Additionally, Takar et al. found that text messages positively affect adherence to medication regimens in chronic diseases (24).

Another method for patient education via mobile phones is the virtual education approach. The advantages of virtual messaging applications include easy access regardless of age, education, race, or place of residence (25). Nowadays, with the increasing expansion of mobile Internet, smartphones, and portable software, telehealth systems have become feasible. Telehealth, or virtual health education, encompasses educational programs, motivating patients to adhere to self-care practices and assist with the regular monitoring of symptoms. Digital technology and multimedia environments are among the factors that promote self-care. Key features of virtual education include easy access, flexibility, the elimination of costly commuting, and referencability (26, 27). A positive effect of using Internet networks in the management of chronic diseases has been reported by Merolli et al. (28). Additionally, the results of Montanomez et al.'s study revealed that messaging applications positively affect physical activity and cardiovascular control, such as systolic and diastolic blood pressure, in adults and the elderly (29).

However, despite evidence supporting the general benefits of mobile-based health interventions, few studies have compared different mobile education approaches specifically targeting self-care behaviors among patients with heart failure, particularly in low-resource contexts.

To address this gap, the present study aimed to compare the effectiveness of two tele-education methods—a one-way automated text-message reminder system and an interactive virtual-space education program via Soroush Messenger—on self-care behaviors in patients with heart failure in Iranshahr, Iran (2024).

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Methods

Study Design

This quasi-experimental study was conducted on patients with heart failure who met the inclusion criteria.

Participants

The sample size was determined to be 60 participants (20 per group) based on Dalir et al.'s study (1), with a 95% confidence interval and 80% statistical power, accounting for potential attrition. Participants were randomly assigned to each group using colored cards: blue (text message group), red (Soroush Messenger group), and green (control group). The inclusion criteria comprised being literate, owning a smartphone, a definitive diagnosis of heart failure confirmed by a physician, and no severe physical and mental disorders.

Data Collection Tools

The research instruments included a demographic information questionnaire, which examined items, such as age, gender, and marital status, and the European Heart Failure Self-Care Behavior Scale. The scale comprises 12 items rated on a five-point Likert scale ranging from 1 = "strongly agree" to 5 = "strongly disagree." The total score ranges from 12 to 60, with lower scores indicating better self-care behavior. Scores between 12–22 reflect good self-care, 23–44 indicate moderate self-care, and 45–60 represent poor self-care (30). The validity of this scale was confirmed using the content validity method, and its reliability was determined using Cronbach's alpha (0.81) (31). In another study, the scientific validity of the Persian version of this instrument was established through content validity, and its internal consistency was reported as 0.68 (Cronbach's alpha coefficient) (32). In this study, the instrument's reliability coefficient, measured by Cronbach's alpha, was 0.71.

Intervention

After obtaining the necessary permissions from the Student Research Committee and receiving the research ethics code IR.IRSHUMS.REC.1403.005, the researcher, accompanied by a research assistant, visited the ward to conduct the study. Among eligible patients, sampling was random, and 20 individuals were allocated to each group.

Initially, the research units were informed about the methodology, confidentiality of information, and the optional nature of continued participation in the study. Written informed consent was then obtained from all participants to participate in the study.

During the pretest phase, the questionnaires were completed by the research units. Subsequently, the intervention was performed on the intervention groups. In the Intervention 1 group (text message reminder), the desired messages were entered into the Auto Message software. This software is web-based and requires no hardware; it was installed on the researcher's mobile phone, making it easily portable and accessible. The time and text messaging settings for sending the dietary regimen text messages, based on the medication instructions in the patient's file, were entered into the Auto Message system in collaboration with the patient. The messages were sent approximately 15 minutes before the scheduled medication use time. Furthermore, the text messages were short, simple, and understandable, with a maximum length of 160 characters. After the final reminder for tablet consumption, the following message was sent to the patient to ensure they had viewed the messages and acted upon them.

Dear patient,

Have you taken your medication today?

Answer: Yes (1) – No (0)

Additionally, given the patient's condition, a daily text message regarding self-care was sent during the day's active hours.

In the Intervention 2 group (Soroush Messenger), the intended messages were entered into the Soroush Auto Message software. This software is web-based and requires no specialized hardware. It was installed on the researcher's mobile phone, making it easily portable and accessible. Therapeutic regimen messages, based on the medication instructions in the patient's file, were sent by the researcher to the patient in collaboration with the patient. The messages were sent approximately 15 minutes prior to the scheduled medication time.

The messages were short, simple, and understandable, and patients received educational videos in Persian. There is no character limit for sending messages on the Soroush Messenger application. Additionally, after reminding the patient to take the last pill, a text message was sent, as in the previous group, to confirm that the message had been viewed and acted upon. Moreover, given the patient's condition, a daily text message regarding self-care was sent during the patient's active hours.

It is worth noting that the self-care messages concerning cardiovascular risk factors, the

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consequences of non-adherence and the benefits of adherence, lifestyle modifications, medications used, smoking cessation methods, selecting low-fat foods, engaging in physical activity, stress management, self-monitoring of blood pressure, waist circumference measurement for overweight control, the body mass index calculation method, and self-monitoring of blood glucose were prepared, adjusted, and sent using reference texts and under the supervision of a specialist physician.

The researcher received the text message delivery report through the software. If the patient did not receive the message for two consecutive days, the researcher contacted them to inquire about the reason. If the patient no longer wished to continue participating in the study, they were excluded, and a replacement participant was recruited. The researcher's contact number was provided to the patients, who were requested to call the researcher if they had any questions or problems. (A research assistant asked for help when the primary researcher was unavailable.) The researcher contacted the research units once every two weeks to inquire about their condition and receive feedback on message reception. After one month, patients were contacted and asked to complete the questionnaires. The control group received educational brochures about the disease, treatment regimen, medication, and lifestyle upon discharge. Data on demographic variables were collected by the researcher through both patient file review and patient interviews. The information was recorded without specifying whether the patient was in the intervention or the control group.

Data Analysis

For data analysis, descriptive statistics, paired t-tests, and analysis of variance (ANOVA) were employed, and the data were analyzed using SPSS software (version 26).

Results

A total of 60 patients participated in this study, including 40 males (66.6%) and 20 females (33.4%), with a mean age of 54.87 ± 16.25 years. Most participants were married (91.6%), and nearly all had a history of illness (98.3%). Regarding ethnicity, almost all participants (98.3%) were of Baluch ethnicity. Regarding family characteristics, two participants had no children, one had 15, and approximately 16% had three to five children. Regarding education, 30 participants (50.0%) had primary education, 17 (28.4%) held a high school diploma, and 13 (21.6%) had a university degree.

Table 1 presents the baseline demographic and clinical characteristics of the three study groups (Control, SMS, and Soroush Messenger). According to chi-square, Fisher's exact, ANOVA, and Kruskal–Wallis tests, no statistically significant differences were found among the groups for age, gender, marital status, education level, occupation, smoking status, or disease history ($P > 0.05$). These findings indicate that the random allocation produced comparable groups at baseline.

The normality of quantitative variables, including self-care behavior scores, was assessed using the Shapiro–Wilk test. As most variables showed approximately normal distribution, parametric tests (paired-samples t-test and one-way ANOVA) were used when assumptions were met. In contrast, non-parametric tests (Wilcoxon signed-rank and Kruskal–Wallis) were applied for non-normally distributed data.

To evaluate the effectiveness of the educational interventions on self-care behaviors, both within-group and between-group analyses were conducted. Within-group comparisons showed statistically significant improvements (i.e., decreased mean scores) after the intervention in both intervention groups. In the Soroush Messenger group, the mean self-care score decreased from 33.17 ± 5.55 before to 26.74 ± 4.54 after the intervention (Wilcoxon test, $P < 0.01$). Similarly, in the SMS group, the score decreased from 34.79 ± 4.92 to 28.42 ± 4.50 (paired-samples t-test, $P < 0.01$). In contrast, no significant change was observed in the control group (34.55 ± 4.42 before vs. 33.82 ± 3.80 after; $P = 0.46$).

Between-group comparisons revealed no statistically significant differences in baseline scores (Kruskal–Wallis test, $P = 0.82$). However, after the intervention, the mean self-care scores differed significantly among the three groups (one-way ANOVA, $P < 0.01$). Tukey's post hoc test showed no significant difference between the SMS and Soroush Messenger groups ($P = 0.38$), while both intervention groups had significantly better outcomes than the control group (Table 2).

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Table 1. Baseline Demographic and Clinical Characteristics of Participants by Study Group (n = 60)

Variable	Category	Soroush Messenger (n = 20)	SMS Group (n = 20)	Control Group (n = 20)	P-value
Age (y)	Mean ± SD	49.61 ± 16.81	55.46 ± 16.99	59.73 ± 13.71	0.19[k]
Gender, No. (%)	Male	12 (60.0)	14 (70.0)	9 (45.0)	0.11[ch]
	Female	8 (40.0)	6 (30.0)	11 (55.0)	
Marital status, No. (%)	Married	18 (90.0)	19 (95.0)	18 (90.0)	0.36[f]
	Single	2 (10.0)	1 (5.0)	2 (10.0)	
Education level, No. (%)	Primary	10 (50.0)	11 (55.0)	9 (45.0)	0.67[f]
	Diploma	5 (25.0)	4 (20.0)	8 (40.0)	
	University	5 (25.0)	5 (25.0)	3 (15.0)	
Occupation, No. (%)	Employed	11 (55.0)	12 (60.0)	10 (50.0)	0.64[f]
	Unemployed	9 (45.0)	8 (40.0)	10 (50.0)	
Smoking, No. (%)	Yes	5 (25.0)	8 (40.0)	6 (30.0)	0.34[ch]
	No	15 (75.0)	12 (60.0)	14 (70.0)	
Disease history, No. (%)	Yes	20 (100)	20 (100)	19 (95.0)	> 0.05[f]
	No	0 (0)	0 (0)	1 (5.0)	

Note: k, Kruskal-Wallis test; f, Fisher; ch, Chi-square.

Table 2. Comparison of Studied Outcomes Within and Between Intervention Groups After the Intervention

Variables		Soroush Messenger Group (Mean ± SD)	Text Message Group (Mean ± SD)	Control Group (Mean ± SD)	Between-Group P-Value
Self-care behaviors of patients with heart failure	Before the intervention	33.17 ± 5.55	34.79 ± 4.92	34.55 ± 4.42	0.82[k]
	After the intervention	26.74 ± 4.54	28.42 ± 4.50	33.82 ± 3.80	0.00[a]
	Within-group *P*-value	< 0.01[w]	< 0.01[t]	0.46[t]	-

Note: SD, standard deviation; t, paired samples t-test; w, Wilcoxon test; k, Kruskal-Wallis test; a, analysis of variance (ANOVA).

Discussion

The results of the current study demonstrated that education via automated text messages and the Soroush Messenger significantly affected the self-care behaviors of patients with heart failure.

The results also revealed similar effects of both educational methods on patients with heart failure, and no statistically significant difference was found between the automated text message and Soroush Messenger groups ($P = 0.38$).

Estaji et al.'s study (2019) in Bojnurd, Iran, investigating the effect of mobile phone text message-based education on patients' adherence to the therapeutic regimen among 30 patients undergoing hemodialysis demonstrated that text message-based education led to a significant increase in patients' adherence to the therapeutic regimen (33). According to a 2019 study by Ahmadi et al. in Tehran, Iran, text messaging improved medication adherence among patients with chronic hyperlipidemia (34). Additionally, Kazemi Majd et al.'s research in 2015 on 60 adolescent patients with epilepsy determined that text message-based education resulted in a significant increase in self-care scores and adherence to the treatment regimens (35). The effect of text messaging on adherence to

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treatment recommendations was also confirmed by Safaei et al.'s (2015) study in Urmia, Iran, among patients with hypertension (36). Similarly, Pernell et al.'s 2017 study in the United States on patients with sickle cell anemia and asthma confirmed the effect of text message reminders on medication adherence (37). As reported in a 2020 study by Guner et al. in Turkey, reminder text messages improve metabolic control and disease management in patients with type 2 diabetes mellitus (38). All studies mentioned above are consistent with the present study, confirming the significant effect of education via automated text message in various patients.

However, a 2014 study by Sugita et al. in Japan concluded that text messaging aimed at improving health literacy had no significant effect on medication adherence among patients with type 2 diabetes (39). The findings of the mentioned research do not align with the results of the current study. Among the reasons for this discrepancy are the manual sending of text messages by the researcher in Sugita et al.'s study versus the automated text messaging by the researcher in the current study, as well as the frequency of text messaging, which was twice a week in Sugita et al.'s study, but daily in the present study.

In a study by Johansson et al. in 2021 in Sweden, the significant effect of education via virtual space and the Internet on depressive symptoms and self-care in cardiac patients was confirmed (40), the results of which align with the findings of the present study concerning the effect of education via virtual space on self-efficacy in patients with heart failure. The results of Eghtedar et al.'s study in 2023 in Urmia, Iran, to investigate the impact of self-care education via the WhatsApp social network, face-to-face training, and telephone follow-up on treatment adherence and readmission in patients with heart failure revealed the significant effect of schooling via virtual space and face-to-face training, with the education via virtual space even having a greater impact than the face-to-face training (41), confirming the results of the present study regarding the effect of schooling via virtual space.

In 2017, Tajari et al. investigated the effects of text message reminders and Telegram on dietary adherence in adolescents with type 1 diabetes mellitus in Gorgan, Iran, and found that education via virtual space and text message reminders significantly improved dietary adherence (42). These findings are consistent with the current study. However, this study also found that the mean dietary adherence scores after the intervention were higher in the Telegram group compared to the text message group. This result is inconsistent with the present study's findings, which found no statistically significant difference between the mean self-care scores of the two intervention groups after the intervention. Potential reasons for this contradiction include factors, such as the use of Telegram in that study, differences in the research population, the variables investigated, the study tools, the type of intervention, and its implementation time.

One limitation of this study was that, although the use of "colored cards" is a randomization method, it is non-standard and prone to selection bias. Given that both text messages and educational content had to be sent to the participants' mobile phones in this study, blinding them was not possible. To address this limitation, efforts were made to involve the research assistant at various stages of implementation and sampling.

Conclusions

Today, mobile phones and virtual spaces are integral to human life. These methods have many advantages, including being cost-effective, convenient, accessible, and time-saving. The results of this research demonstrated that education via both automated text message and the Soroush Messenger significantly affected the self-care behaviors of patients with heart failure. Given the similar effects of these two educational methods on improving self-care behaviors of patients with heart failure and their many benefits, their use is recommended due to patients' easier access to each technique.

Ethics Approval and Consent to Participate

This study was approved by the Research Ethics Committee of the Iranshahr University of Medical Sciences (ethics code: IR.IRSHUMS.REC.1403.005). Informed written consent was obtained from all participants after providing sufficient explanations regarding the

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research, methodology, and voluntary nature of participation in the study. The principle of confidentiality was observed throughout all stages of the study.

Consent for Publication

Not applicable.

Data Availability Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Authors' Contribution

MO and MJB collected data from patients with heart failure and conducted the intervention. OP, SD, and FS wrote the initial proposal. FS wrote the manuscript. SD and FS analyzed data on the self-care of patients with heart failure. All authors read and approved the article.

Conflict of Interest

The authors declared no conflicts of interest.

Declaration of Generative Artificial Intelligence (AI) in Scientific Writing

The authors have not used any AI tools or technologies to prepare this manuscript.

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