


Acceptability, feasibility, and effectiveness of smartphone-based delivery of written educational materials in Iranian patients with coronary artery disease: A randomized control trial study

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Funding information

Mashhad University of Medical Sciences, Grant/Award Number: 970614

Abstract

Background and Aims: Providing education to patients with coronary artery disease (CAD) is one of the crucial roles of nurses and, there are various education methods for these patients. This study aimed to investigate the acceptability, feasibility, and effectiveness of smartphone-based delivery (SPBD) of written educational materials in Iranian patients with CAD.

Methods: A total of 104 patients with CAD who were admitted to the cardiovascular unit of a large hospital in the northeast of Iran were randomly divided into control and intervention groups. When the standard educational content was provided, educational materials were delivered to the intervention group using a SPBD and to the control group using the routine print delivery (PD). The authors investigated the usability in the postintervention phase and information satisfaction and medication self-efficacy in the pre- and postintervention phases.

Results: The mean age and the standard deviation of “patients” age in SPBD and PD groups was 51.8 ± 1.1 and 52.7 ± 1.3 years, respectively. No significant difference was observed between the two groups in terms of mean information satisfaction score ($p = 0.726$); however, the information satisfaction score was significantly higher in the SPBD group than PD group after the intervention ($p = 0.012$). The findings showed no statistically difference between two groups in terms of usability score ($p > 0.05$). The two groups were homogenous in terms of the mean medication self-efficacy score in the preintervention phase ($p = 0.987$); however, it was significantly higher in SPBD group than PD group in the postintervention phase ($p = 0.045$).

Conclusion: The SPBD method had the same usability as the PD method and at the same time this method was more effective in promoting medication

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self-efficacy. Therefore, SPBD could be used to educate patients with CAD and their caregivers and have appropriate effectiveness and acceptability among the Iranian population.

KEYWORDS

acceptability, coronary artery disease, feasibility, patient education, self-efficacy

1 | INTRODUCTION

Coronary artery disease (CAD) is one of the leading cause of death and disability in developed countries.¹ The prevalence of CAD and its risk factors in Iran is the same as in Western countries. Despite many developments in diagnostic and therapeutic methods, CAD still accounts 20%–23% of the burden of diseases in Iran, which may be due to lifestyle changes associated with industrialization and urbanization, increased risk factors such as unhealthy eating habits and inadequate physical activities, poor access and low cost-effectiveness of primary care, and lack of adherence to treatment regimen due to economic problems, and poor awareness.^{2,3} Therefore, most cardiovascular risk factors are modifiable and may be controlled by individuals through changing their life styles, personal habits, or medication use as one of the main treatments.⁴ In this regard, the use of educational programs as one of the essential tools in changing patients' lifestyle has a profound effect on enhancing healthy behaviors, adherence to treatment regimens, and promoting their self-care.⁵ American Heart Association, American College of Cardiology, and European Heart Association have identified education as an essential component of cardiac rehabilitation programs.^{6,7} Educational interventions enhance care and patients level of knowledge and facilitate the process of behavior change. In addition, increased medication adherence and improvement of cardiac symptoms are other outcomes of education in patients with cardiovascular diseases.⁸

Patient education is one of the most important tasks of care providers, especially nurses.⁹ However, one of the barriers to the patient education in Iran is shortage of time due to high workload and the disproportionate patient-nurse ratio.¹⁰ Use of educational materials is one of the methods to overcome these barriers. Besides, saving time, these tools will increase motivation and depths of learning among clients.¹¹ Despite the abundance of information available in various educational media, written educational materials provided to the target audiences by medical centers are used by patients as the primary source of information.^{12,13} Written educational materials such as leaflets, booklets, pamphlets, and brochures, instruction sheets are the most widely available types of educational tools and are most commonly used as a traditional method.¹¹ One of Iran's most common printed tools is educational pamphlets used in crowded medical centers.¹⁴ However, the management-related barriers, especially shortage of funds cause problems for the delivery of this educational tool. Consequently, it is impossible to deliver and produce sufficient copies of pamphlets prepared at healthcare

centers across Iran. Thus, the current traditional educational methods do not seem to meet the ever-changing needs of societies in the informatics world.¹⁵

E-learning enables teaching and learning in any context at any time and place by relying on the Information technology-based teaching and training methods. One of the e-learning methods is mobile phone-based education.¹⁶ The use of mobile technology in developing countries has increased awareness among patients regarding their healthcare, today.^{17,18} Mobile phone provides an opportunity to improve access to health promotion intervention and has a unique advantage, that is, the ability to affect health behaviors in real time.¹⁹ Despite its many capabilities, such as easy access, accessibility at any time and place, ability to communicate, and send information in a variety of ways, as it is completely technology-based, it may not be used by people having different social, cultural, and information levels.^{20,21} In a study on mobile phone-based education in India, Fozdar & Kumar²² stated that 69.2% of people consider mobile phones as an immediate learning tool, 72.2% regard mobile phone-based learning as a new opportunity, and 66.2% believe that it has fast feedback. A total of 73.4% of the participants also believed that this educational method ensures temporal, and spatial flexibility during the learning and is more inclusive than other educational methods. Based on literature review, there is no study on the use of smartphones for patient education in Iran. Therefore, it is necessary to investigate acceptability and feasibility of the intervention on the target population.²³

Therefore, the first objective of the present study was to investigate the acceptability and feasibility of smartphone-based delivery (SPBD) of written educational materials in Iranian patients with CAD. The second objective of the present study was to investigate the effectiveness and potential of this intervention in the process of behavior change, which was achieved by evaluating the short-term effect of using smartphone-based educational content on the medication self-efficacy as a predictors of medication adherence.

2 | MATERIALS AND METHODS

2.1 | Study design

This study was conducted with randomized controlled trial design approved in the Iranian registry of clinical trials system (IRCT20180903040938N1).

2.2 | Participants

The current study was performed on the 104 patients with CAD admitted to the cardiovascular unit and referred to the health education clinic of Ghaem hospital, Mashhad in the northeast of Iran, from February 2018 to April 2019. The cardiovascular unit of this hospital, with occupancy rate of over 95%, has 11 rooms and 41 beds. Routine pre-angiographic preparation was provided to the patient in the form of a training sheet upon making appointments, and other inpatient training was also provided by nurses verbally and occasionally through pamphlets. Every morning, the first author was present in the cardiovascular unit except on holidays and selected qualified patients from the list of CAD patients on the previous day. The health education clinic is also located in the hospital clinic where patients and their families are provided with necessary training on self-care, pharmacological and surgical treatments, nutrition, and activity by faculty members of the Faculty of Nursing and Midwifery. One day a week was dedicated to the cardiovascular clinic and patients were referred to the health education clinic after being visited by a cardiologist. Therefore, the first author attended the cardiovascular clinic on that day.

Inclusion criteria included patients aged 18–60 years, full consciousness (The Glasgow Coma Scale = 15), minimum level of literacy to reading and writing in patients or their main caregiver (primary school), patients' or caregivers ability to read and their visual acuity, having a smartphone, a stable hemodynamic status, no history of patients or their caregivers participating in CAD-related training interventions, being admitted for at least 24 h (for inpatients), the patient's primary caregiver be a first-degree relative, the caregiver is responsible for direct care of the patient for at least 12 h a day. Exclusion criteria also included patients with unstable hemodynamic status, discharge, or transfer of the patient from the cardiovascular ward earlier than 24 h.

2.3 | Interventions

The present study was conducted after obtaining the approval of the Ethics Committee (IR.MUMS.NURSE.REC.1397.045) and coordinating with the authorities of the Department of Cardiology and Health Education Clinic of Ghaem hospital in Mashhad, northeastern Iran.

In the first step, the first author received a file of all CAD-related pamphlet used in the hospital from the patient education department. She reviewed and prepared the required pamphlets based on the existing standards. Then the quality of pamphlets was checked by cardiologists based on the checklist.¹¹ Suitability assessment of materials (SAM) and simplified measure of gobbledygoo (SMOG) were used to assess suitability and readability, respectively.^{14,24} The mean and standard deviation of the readability level of the pamphlets prepared based on SMOG was 6.6 ± 1.3 and the mean and the standard deviation of the suitability of the pamphlets prepared based on the SAM was also 39.5 ± 1.4 out of 44 after examining six domains, including contents, literacy demand, graphics, layout and

typography, learning stimulation and motivation, and cultural appropriateness. Therefore, the mean readability level of the pamphlets was almost equal to the seventh grade (confirm the inclusion criterion) and the suitability was also assessed to be excellent (Table 1).

In the second step, the first author uploaded the electronic file of the educational materials (pamphlets) on the hospital wireless network. There was a router in the nursing station of the cardiovascular unit to use in-patient education service. Another wireless device was also installed in the health education clinic of the hospital's waiting room and education materials were uploaded in the same manner. The size of the applied fonts in the used educational materials was set at 12 with single spacing. The pamphlets were copied and distributed to the control group in a routine manner by the patient education coordinating nurse.

In the third step, after the first author explained objectives and methods of the research, and provided the consent form to the participants, demographic and disease characterizes questionnaire was completed in either group by interviewing patients or their primary caregivers and using information contained in their medical case. Information satisfaction questionnaire (ISQ) and self-efficacy for appropriate medication use (SEAMS) questionnaires were also completed for patients admitted to the cardiovascular unit ($n = 42$ patients in each PBPD and print delivery [PD] groups) and the health education clinic ($n = 10$ per PBPD and PD groups). Concerning illiterate patients, the questionnaire was given to their primary caregivers to read the questions for the patients and record their responses in it. The average time required to complete the questionnaires was 10 min.

In the fourth step, the same educational content was delivered to the intervention group using SPBD method and control group using PD (pamphlet). Both groups received verbal education provided by nurses using routine method, and the content of educational materials delivered using SPBD and PD was similar.

In the intervention group, the first author provided the patients and their primary caregivers with an instruction sheet containing information on educational materials. This sheet describes connection procedure using pictures in a step by step manner. The patients were later connected to the electronic webpage containing educational materials via smartphone's Wi-Fi without the need to Internet connection. This page displays educational content in three main topics: disease and care approaches, diagnostic and therapeutic methods, and medications. The patients could access the relevant educational materials by selecting each of them. The first author determined the patient's educational needs in the instruction sheet based on the information received in the demographic and disease characteristics questionnaire. Accordingly, the patients downloaded the educational materials and stored them on their smartphone.

The first author placed the printed pamphlets in the intended place, identified the educational needs of these patients, and provided explanations on the use of pamphlets to the patients and their primary caregivers, in the control group. Similarly, educational materials were delivered in both group at the health education clinic.

TABLE 1 Readability and suitability of pamphlets based on SAM and SMOG tools

Title	SMOG Readability level	SAM						Total score (44)
		Content	Literacy demand	Graphics	Layout and typography	Learning stimulation and motivation	Cultural appropriateness	
Myocardial infarction	5	7	10	8	6	4	6	41
Angina	8	7	8	8	6	6	4	39
Atherosclerosis	6	7	8	6	5	6	4	36
Coronary artery disease	8	6	9	6	6	6	4	37
Cardiac diet	8	6	10	8	6	6	4	40
Constipation prevention	6	8	10	6	6	6	4	40
Hyperlipidemia	7	7	9	10	6	5	4	41
Hypertension	7	7	9	9	5	5	4	39
Hypertension diet	7	8	9	10	6	6	4	43
Diabetes	7	7	9	10	6	6	4	42
Exercise and diabetes	6	7	9	9	5	5	4	39
Insulin injection	6	8	10	10	5	6	4	43
Angiography	6	8	9	6	6	6	4	39
Angioplasty—stent	8	8	9	6	6	6	4	39
Balloon angioplasty	8	6	9	6	6	6	4	37
Eco cardiography	6	6	10	6	6	3	4	35
Cardiac stress test	8	8	9	8	6	6	4	41
Preoperative care of open heart surgery	7	8	9	7	4	4	4	36
Postoperative care of open heart surgery	7	7	9	8	5	5	4	38
Cardiovascular drugs—Aspirin	6	8	10	6	6	4	6	40
Cardiovascular drugs—Clopidogrel (Plavix)	6	8	9	6	9	4	6	42
Cardiovascular drugs—beta blockers	5	7	10	9	5	5	4	40
Cardiovascular drugs—nitrates	8	8	10	9	6	6	3	42
Cardiovascular drugs—Ca blockers	7	8	9	9	5	5	4	40
Cardiovascular drugs—ACE inhibitors	6	7	9	10	6	4	4	40
Cardiovascular drugs—Diuretics	6	8	10	9	5	5	4	41
Cardiovascular drugs—Warfarin	6	6	5	10	6	6	4	37
Cardiovascular drugs—statins	6	8	10	5	6	6	4	39
Total mean ± SD	6.6 ± 1.3	39.5 ± 1.4						

Abbreviations: SAM, suitability assessment of materials; SMOG, simplified measure of gobbledygoo.

It should be noted that pamphlets were collected in the SPBD group and the wireless device was switched off in the PD group each week according to the specified sequence.

2.4 | Data collection tools

The variables such as information satisfaction, user experience, and self-efficacy for appropriate medication were considered as primary

outcomes. In the present study, data were collected by a trained nurse under the supervision of the first author using questionnaires. Finally, after performing statistical analysis by a statistical consultant, they were assessed by the first author. So, data collection tools included subject selection form, demographic and disease characteristics questionnaire, ISQ, user experience questionnaire (UEQ), and SEAMS.

Thomas et al.'s²⁵ information satisfaction questionnaire consisted of three sections: demographic information, information need

(desire to receive complete information and participation in the treatment decisions, desire to receive positive information about disease and desire to receive limited information, and physician-based decision making), and satisfaction with information on illness, side effects, types of treatments available, lifestyle, practical day-day issues, and overall information provided. This 6-item questionnaire was scored based on a five-point Likert scale ranging from very satisfied (4) to very unsatisfied (0). The total score was categorized into excellent (20–24), good (15–19), moderate (10–14), poor (5–9), and very poor (0–4) levels of information satisfaction. Therefore, the highest and lowest information satisfaction was represented by scores 24 and 0, respectively.²⁵ This questionnaire has been used by various researchers such as Davies et al.,²⁶ and Pollock et al.,²⁷ to measure information satisfaction of cancer patients; however, it has not been translated into Persian yet. Therefore, after obtaining permissions, this instrument was translated into Persian by the research team, and the translation accuracy was then checked by an English language expert and then translated back into English. The original version of the questionnaire was compared with the translated version. The content validity index (CVI) was estimated based on Waltz and Bausell CVI²⁸ (the minimum acceptable value for CVI = 0.79).²⁹ The CVI for all questionnaire items ranged from 0.79 to 0.83 in the present study. Therefore, after matching the two versions of the translation, the validity of the translation was confirmed by a mean CVI value of 0.81 based on the opinions of 10 experts. The instrument's reliability was also confirmed by calculating Cronbach's α coefficient in 10 patients during the pilot study ($\alpha = 0.976$).

UEQ was first designed by Laugwitz in German³⁰ and has been translated into several languages so far.³¹ The questionnaire consists of six sections: attractiveness (six items), perspicuity (four items), efficiency (four items), dependability (four items), stimulation (four items), and novelty (four items). Therefore, it consists 26 questions, consisting of pairs of contrasting attributes that illustrate the individual's sense of the subject under study. The possible score range is -3 (most negative impression) to $+3$ (most positive impression), with values close to 2 showing optimal impression. UEQ is often used to evaluate the feasibility of a product by collecting some quantitative data about participants' experience.^{32,33} The validity and reliability of this questionnaire has been conformed in several languages. Studies of the original German questionnaire and its English version show an acceptable construct validity and reliability using Cronbach's α method ($\alpha > 0.7$ for all dimensions).³⁰ The reliability and validity of UEQ have also been evaluated in several studies.^{33–35} The reliability of this instrument in the present study was confirmed by internal consistency with Cronbach's α coefficient of 0.859 and the validity of the Persian version was assessed using the qualitative content validity method.

SEAMS Risser, et al.,³⁶ designed by a team of experts, consists of 13 items scored based on a three-point Likert scale (unconfident, fairly confident, and extremely confident). The SEAMS scale was utilized as an appropriate tool for assessing patients' adherence to treatment. The possible score range was 13–39, with higher scores

indicating higher levels of medication self-efficacy. The scores obtained from the SEAMS scale were considered as the patients' adherence to the treatment. Validity of this questionnaire was also confirmed in a study on 436 patients with CAD and its reliability was confirmed by tested-test, Spearman's correlation coefficient (0.57), and Cronbach's α (0.89). Sanchooli et al.³⁷ also confirmed the face validity and content validity of the Persian version of this questionnaire. The reliability of this instrument was also confirmed by using the Cronbach's α coefficient of 0.81, and Spearman's correlation coefficient of 0.97 and 0.77 by split-half method. The reliability of the questionnaire was also confirmed by Cronbach's α coefficient of 0.804 in the present study.

To evaluate usability and information satisfaction 24 h later, UEQ and ISQ questionnaires were given to the patients, respectively. The first author completed these questionnaires at the health education clinic by phone interview 24 h after the outpatient visit. The telephone contact numbers of patients or their primary caregiver were obtained in the preintervention phase and the call time was set for the next 24 h. The SEAMS questionnaire was also completed 1 week after the discharge of the patients in the same manner. In addition, the number of pamphlets received in the PD group was figured out, and the number of pamphlets downloaded from the smartphone in the SPBD group was also obtained from the designed electronic page and compared with the number of items required based on patient's educational needs (Figure 1).

2.5 | Sample size

Based on a pilot study of 20 patients (10 patients in each group), the sample size was calculated 47 individuals in each group, considering 95% confidence interval, test power = 80%, and the mean comparison formula of two independent societies. Finally, the total sample size increased to 104 individuals ($n = 52$ individuals per group), considering possible 10% dropout.

2.6 | Randomization

Participants were selected from patients with CAD admitted to the cardiovascular unit and referred to the education clinic, using convenient sampling. Then they are randomly assigned to SPBD and PD groups. A random sequence of 1-week time blocks was prepared by statistical consultant using SPSS software to prevent contact and information exchange among patients. This procedure was also performed with regard to patients admitted to the health clinic simultaneously. This sequence was then kept in a sealed pocket, and subjects were randomly allocated by the first author (F. N.) to the control or intervention group at the beginning of each week. Accordingly, all patients included in this study were divided into one of the two groups at that week based on time blocking method.

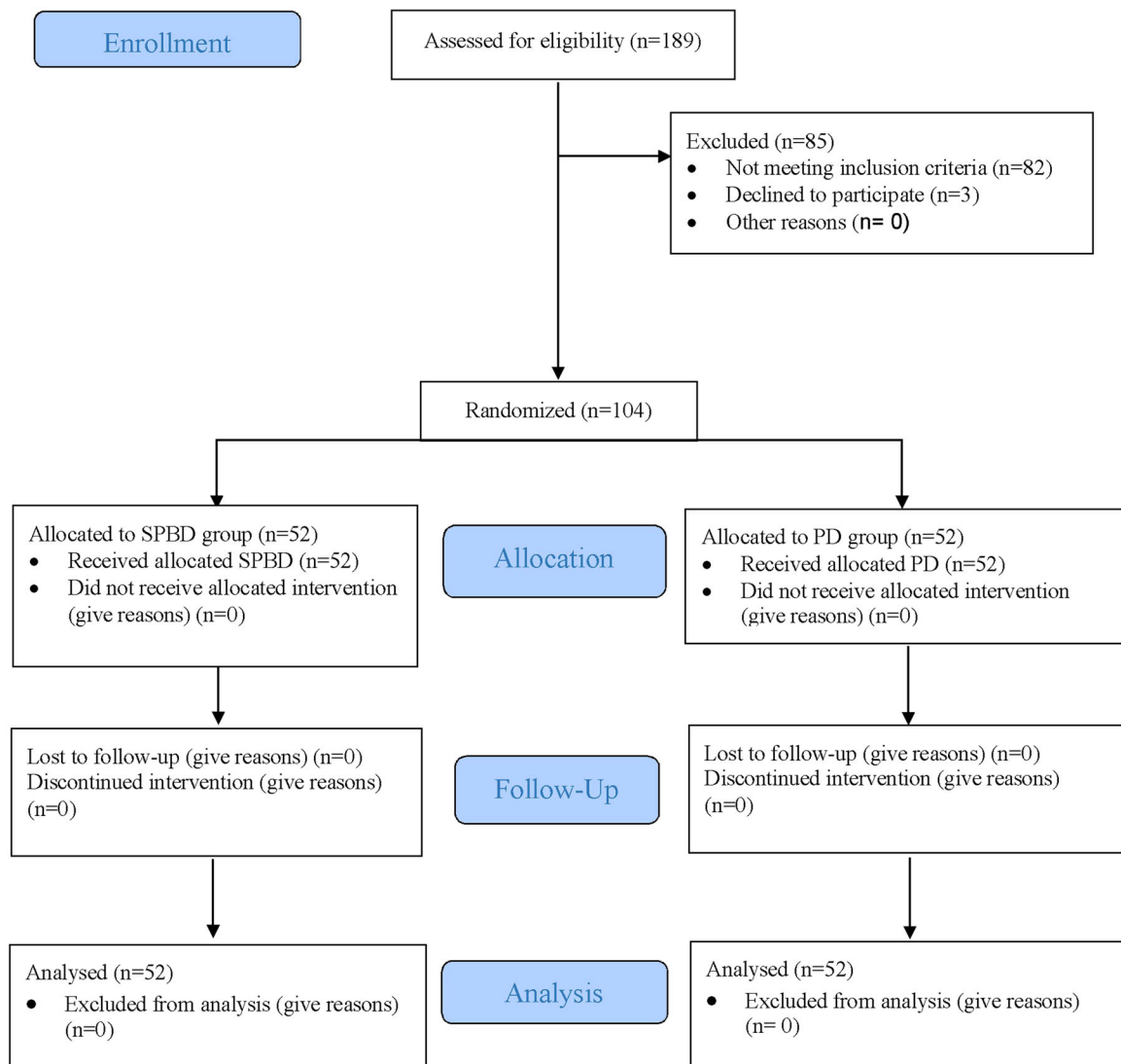


FIGURE 1 Flow chart of the study. PD, print delivery; SPBD, smartphone-based delivery.

2.7 | Blinding

In the present study, the statistical consultant and data collector were blinded to the allocation of the participants in two groups.

2.8 | Statistical analysis

The normal distribution of quantitative variables was determined using Kolmogorov–Smirnov and Shapiro–Wilk statistical tests. Independent t-test, Mann–Whitney, and χ^2 tests were used to investigate the homogeneity of the two groups in terms of underlying and confounding variables. To achieve the objectives of the study, Wilcoxon and McNemar tests were used to carry out intragroup comparisons and Mann–Whitney, Fisher, and χ^2 tests were used to carry out intergroup comparisons. To determine the relationship between individual characteristics and the effect of intervention, two-way analysis of variance (ANOVA) was used. All of the main assessed variables were considered the primary outcomes.

3 | RESULTS

3.1 | Baseline characteristics

Mean \pm SD of patients' age in SPBD and PD groups was 51.8 ± 1.1 and 52.7 ± 1.3 years, respectively. The statistical test results revealed no statistically significant difference between the two groups in terms of age, sex, marital status, educational level, occupation, cause of hospitalization, and other underlying and confounding variables, and the two groups were thus homogeneous (Table 2).

3.2 | Evaluation of the acceptability and feasibility

To assess acceptability, we evaluated patients' information satisfaction in three dimensions of information need, ability to provide better information, and information satisfaction.

TABLE 2 Comparison of the demographic characteristics of patient in two groups

Variables		Group		Results of the intergroup test
		PD (n = 52)	SPBD (n = 52)	
Gender (% number)	Male	15 (28.8%)	18 (34.6%)	$p = 0.527^*$
	Female	37 (71.2%)	34 (65.4%)	
Marital status (% number)	Single	4 (7.6%)	1 (1.9%)	$p = 0.205^{**}$
	Married	37 (71.2%)	45 (86.5%)	
	Deceased spouse	11 (21.2%)	6 (11.5%)	
Level of education (% number)	Under diploma	29 (55.8%)	27 (51.9%)	$p = 0.567^{***}$
	Diploma	16 (30.8%)	15 (28.8%)	
	University degree	7 (13.5%)	10 (19.2%)	
Occupational status (% number)	Housewife	34 (65.4%)	31 (59.6%)	$p = 0.975^{**}$
	Self-employed	9 (17.3%)	11 (21.2%)	
	Employee	3 (5.8%)	4 (7.7%)	
	Worker	5 (9.6%)	5 (9.6%)	
	Unemployed	1 (1.9%)	1 (1.9%)	
Patient income (% number)	Less than expenditure	28 (57.1%)	26 (54.2%)	$p = 0.786^*$
	The same as expenditure	21 (42.9%)	22 (45.8%)	
Reason for admission (% number)	Angiography	38 (73.1%)	40 (76.9%)	$p = 0.698^{**}$
	Myocardial infarction	10 (19.2%)	10 (19.2%)	
	Angina	4 (7.7%)	2 (3.8%)	
Smoking history (% number)	Yes	2 (3.8%)	6 (11.5%)	$p = 0.269^{**}$
	No	50 (96.2%)	46 (88.5%)	
Hookah history (% number)	Yes	10 (19.2%)	7 (13.5%)	$p = 0.597^{**}$
	No	42 (80.8%)	45 (86.5%)	
Other chronic diseases (% number)	Diabetes	33 (63.5%)	37 (71.2%)	$p = 0.403^*$
	Hypertension	35 (67.3%)	33 (63.5%)	$p = 0.680^*$
	Renal disease	3 (5.8%)	4 (7.7%)	$p = 0.500^{**}$
	Hyperlipidemia	31 (59.6%)	29 (55.8%)	$p = 0.691^*$
Medications used in the last month (% number)	Anti-hypertensive	5 (12.5%)	6 (16.7%)	$p = 0.833^{**}$
	Antidiabetic	3 (7.5%)	1 (2.8%)	
	statin	2 (5.0%)	2 (5.6%)	
	Anti-hypertensive + antidiabetic	4 (10.0%)	1 (2.8%)	
	Anti-hypertensive + statin	14 (35.0%)	13 (36.1%)	
	Antidiabetic + statin	1 (2.5%)	2 (5.6%)	
	Anti-hypertensive + vitamin + statin	0 (0.0%)	1 (2.8%)	
	Antidiabetic + anti-hypertensive + statin	10 (25.0%)	10 (27.8%)	
	Vitamin + antidiabetic + statin	1 (2.5%)	0 (0.0%)	
Family history of cardiovascular disease (% number)	Yes	27 (51.9%)	25 (48.1%)	$p = 0.695^*$
	No	25 (48.1%)	27 (51.9%)	
Required information about disease (% number)	The nature of the disease	1 (1.9%)	2 (3.8%)	$p = 0.654^*$
	Types of available treatments	18 (34.6%)	15 (28.8%)	

(Continues)

TABLE 2 (Continued)

Variables		Group		Results of the intergroup test
		PD (n = 52)	SPBD (n = 52)	
	Complications	10 (19.2%)	7 (13.5%)	
	Lifestyle (diet, activity, etc.)	23 (44.2%)	28 (53.8%)	
preferred information sources to receive information (% number)	Physicians	29 (55.8%)	34 (65.4%)	$p = 0.101^{**}$
	Nurses	21 (40.4%)	12 (23.1%)	
	Family members	0 (0.0%)	3 (5.8%)	
	Internet and social networks	2 (3.8%)	3 (5.8%)	
Information sources used to receive information (% number)	Nurses	31 (59.6%)	27 (51.9%)	$p = 0.597^{**}$
	Physicians	13 (25.0%)	11 (21.2%)	
	Family members	2 (3.8%)	2 (3.8%)	
	Internet and social networks	6 (11.5%)	11 (21.2%)	
	Pamphlet and brochure	0 (0.0%)	1 (1.9%)	
Age (year) mean \pm standard deviation		52.7 \pm 1.3	51.8 \pm 1.1	$p = 0.391^{***}$
Body mass index (kg/m ²) mean \pm standard deviation		26.7 \pm 5.6	27.3 \pm 6.4	$p = 0.631^{****}$
Number of admission or referral Mean \pm standard deviation		1.1 \pm 0.4	1.1 \pm 0.3	$p = 0.641^{****}$

Abbreviations: PD, print delivery; SPBD, smartphone-based delivery.

*The χ^2 test.

**The Fisher's exact test.

***The Mann–Whitney U test.

****The Independent t -test.

Results of Fisher's exact test showed no statistically significant difference between the two groups in terms of the frequency of patients' information needs in SPBD and PD groups before the intervention ($p = 0.596$) and after the intervention ($p = 1.000$). In addition, results of intragroup comparison using Wilcoxon test showed that the frequency of patients' information needs was not significantly different in SPBD ($p = 0.317$) and PD ($p = 1.000$) groups after the intervention (Table 3).

Results of the χ^2 test showed no significant difference between the two groups in terms of frequency of patients who believe that information delivery could be done better in the preintervention ($p = 0.240$) and postintervention phase ($p = 0.152$). Results of intragroup comparison using McNemar tests showed that the frequency of these patients was significantly decreased in the two groups in the postintervention phase, as compared with the preintervention phase ($p = 0.000$) (Table 3).

In the preintervention phase, results of Mann–Whitney test showed no significant difference between information satisfaction scores in SPBD group (5.8 ± 5.3 out of 24) and PD group (5.4 ± 5.4 out of 24) ($p = 0.726$). However, the results of Mann–Whitney test revealed that mean information satisfaction score in the SPBD group (19.5 ± 2.9 out of 24) was significantly higher than that the PD group (17.7 ± 3.5 out of 24) ($p = 0.012$) after the intervention. Besides, results of intragroup comparison using Wilcoxon test showed that mean information satisfaction score

increased significantly in both group after the intervention ($p < 0.001$) (Table 3).

The feasibility of using educational materials was evaluated using UEQ. Results of Mann–Whitney tests showed no significant difference between the two groups in terms of usability score in attractiveness ($p = 0.214$), perspicuity ($p = 0.945$), efficiency ($p = 0.989$), dependability ($p = 0.386$), stimulation ($p = 0.909$), and novelty dimensions ($p = 0.712$) (Table 3). In addition, results of Mann–Whitney tests showed no significant difference between the two groups in the mean number of pamphlets they required ($p = 0.114$) but the mean number of pamphlets they received was significantly difference between the two groups ($p < 0.001$). It should be noted that the number of pamphlets they received is based on patients' self-report in the PD group and according to statistics provided in the design webpage and after eliminating the duplicate downloads, the number of pamphlets downloaded via smartphones in the SPBD group was considered (Table 3).

3.3 | Effects on medication self-efficacy

Results of Mann–Whitney test showed no significant difference in mean medication self-efficacy scores in the SPBD (28.5 ± 8.7 out of 39) and PD groups (28.0 ± 8.9 out of 39) in the preintervention phase ($p = 0.987$). However, the same test

TABLE 3 Acceptability and feasibility of written materials in SPBD and PD groups

Variables			Group		Test result
			PD (n = 52)	SPBD (n = 52)	
Information satisfaction	Information needs (% number)	Receiving all the information and participate in decision making	Pretest 46 (88.5%)	45 (86.5%)	$p = 0.596^*$
			Posttest 46 (88.5%)	46 (88.5%)	$p = 1.000^*$
		Receiving positive information	Pretest 6 (11.5%)	5 (9.6%)	$p = 0.596^*$
			Posttest 6 (11.5%)	5 (9.6%)	$p = 1.000^*$
		Receiving limited information and make decision by the doctor	Pretest 0 (0.0%)	2 (3.8%)	$p = 0.596^*$
			Posttest 0 (0.0%)	1 (1.9%)	$p = 1.000^*$
	Intragroup comparison		$P = 1.000^{**}$	$p = 0.317^{**}$	
	Need for better provision of information (% number)	Yes	Pretest 50 (96.2%)	47 (90.4%)	$p = 0.437^*$
			Posttest 22 (42.3%)	15 (28.8%)	$p = 0.152^{***}$
		No	Pretest 2 (3.8%)	5 (9.6%)	$p = 0.437^*$
		Posttest 30 (57.7%)	37 (71.2%)	$p = 0.152^{***}$	
Intragroup comparison		$p < 0.001^{****}$	$p < 0.001^{****}$		
Information satisfaction (mean ± SD)	Pretest	5.4 ± 5.4	5.8 ± 5.3	$p = 0.726^{*****}$	
	Posttest	17.7 ± 3.5	19.5 ± 2.9	$p = 0.012^{*****}$	
	Intragroup comparison	$p < 0.001^{**}$	$p < 0.001^{**}$		
Usability (mean ± SD)	Attractiveness	Posttest 2.6 ± 0.3	2.6 ± 0.4	$p = 0.214^{*****}$	
	Perspicuity	2.2 ± 0.2	2.2 ± 0.4	$p = 0.945^{*****}$	
	Efficiency	2.4 ± 0.3	2.4 ± 0.2	$p = 0.989^{*****}$	
	Dependability	2.2 ± 0.2	2.2 ± 0.2	$p = 0.386^{*****}$	
	Stimulation	2.1 ± 0.2	2.1 ± 0.3	$p = 0.909^{*****}$	
	Novelty	2.1 ± 0.3	2.1 ± 0.2	$p = 0.712^{*****}$	
Number of pamphlets	Required	Posttest 16.8 ± 3.6	15.6 ± 4.6	$p = 0.114^{*****}$	
	Received	16.3 ± 3.8	21.88 ± 3.4	$p < 0.00^{*****}$	

Abbreviations: PD, print delivery; SPBD, smartphone-based delivery.

*The Fisher's exact test.

**The Wilcoxon test.

***The χ^2 test.

****The McNemar's test.

*****The Mann-Whitney U test.

showed that the mean medication self-efficacy score was significantly higher in the SPBD group (35.2 ± 4.3 out of 39) than the PD group (32.5 ± 6.4 out of 39) after the intervention ($p = 0.045$). In addition, results of intragroup comparison using the Wilcoxon test showed that the mean medication self-efficacy score was significantly increased in both groups after the infant intervention ($p < 0.001$) (Table 4).

Moreover, the results of two-way ANOVA showed that gender had a significant interaction on information satisfaction score after intervention ($p = 0.006$). The above test also showed that other underlying variables had no significant effect on information satisfaction, usability, on medication self-efficacy ($p > 0.05$).

4 | DISCUSSION

The present study aimed to investigate the acceptability, feasibility, and effectiveness of the SPBD of written educational materials to patients with CAD.

Findings showed that the optimal usability of education materials in SPBD and PD groups showed no significant difference between the two groups. Therefore, it is possible to use smartphones to deliver written educational materials as much as the printed method. Similarly, Desteghe et al.³⁸ found that web-based education (e-learning of general information on atrial fibrillation, oral anticoagulant drugs, and information about procedures through videos,

Variables		Group		Test result
		PD (n = 52) Mean ± SD	SPBD (n = 52) Mean ± SD	
Self-efficacy of appropriate medication use	Pretest	28.0 ± 8.9	28.5 ± 8.7	$p = 0.987^*$
	Posttest	32.5 ± 6.4	35.2 ± 4.3	$p = 0.045^*$
	Intragroup comparison	$p < 0.001^{**}$	$p < 0.001^{**}$	

Abbreviations: PD, print delivery; SPBD, smartphone-based delivery.

*The Mann–Whitney U test.

**The Wilcoxon test.

TABLE 4 Mean and standard deviation of medication self-efficacy in SPBD and PD groups

texts, and images) compared to the routine care (receiving information through a cardiologist, atrial fibrillation brochure and a specialized Procedures information booklet) have positive results in all dimension of usability, including attractiveness, perspicuity, efficiency, dependability, stimulation, and novelty in 120 patients with atrial fibrillation. Similarly, the results of a study by Ramezani et al.¹⁴ and Behboudifar et al.³⁹ in a similar context to this study, showed that pamphlet is a popular educational material in Iranian hospitals and has been efficient in some areas. However, despite high age, and low educational level of patients in this study, the usability of SPBD method was the same as PD method. Achieving the same results can be attributed to the fact that the current advances in information technology have led to dramatic changes in society's cultural, social, and economic life. Technology has become a part of our culture and is widely used in educational settings.¹¹ In addition, the mean number of downloads of educational materials in the SPBD group was higher than the mean numbers required. In comparison, the same number was lower in the PD group, which may be due to multiple mobile phone capabilities such as convenient access, availability at any time and place, and the ability to send information.²⁰

Results also revealed that the SPBD method can provide more information satisfaction than the PD method in these patients, so the SPBD method has higher acceptability than the PD method. Similarly, Cho et al.⁴⁰ showed that 85%–95% of patients were satisfied with components, content, layout, and usefulness of information received by smartphone application as a learning tool for patients with CAD. Sakakibara et al.⁴¹ also showed that many women were highly satisfied with the phone-based peer support program (circle healing).

In addition, the results showed that SPBD method was more effective in promoting medication self-efficacy of CAD patients than the PD method. Similarly, Park et al.'s⁴² also supported the effectiveness of mobile-based education in promoting adherence to antiplatelet drug therapy during the 30 days of vulnerability after myocardial infarction or percutaneous coronary interventions. Previous studies showed that the use of new technologies such as mobile applications as one of the influential factors in promoting medication self-efficacy.^{43,44} Achieving the same results, despite the use of different tools as well as variety of interventions and methods of using the smartphone capabilities, can be attributed to the fact that the information technology and internet advances as well as

numerous advantages such as easy access, availability at any time and place, communication and information transfer capability,⁴⁵ facilitate the learning process, and improve the information satisfaction, as one of the factors affecting patient satisfaction is the teaching method.⁴⁶ Thus, as learning enhances, patients receive more information about their disease and can participate effectively in their treatment course.¹¹ Thus, medication self-efficacy and subsequent medication adherence are likely to increase. It is worth noting that the incremental changes in information satisfaction score in both groups is approximately 15 score, which seems to be due to the low readability level and optimal quality of educational content in both groups.

According to the findings, the mean information satisfaction score was higher in men of SPBD group and women of PD group after the intervention. Grimus⁴⁷ showed in a review study that men have more positive attitudes toward using technology during the learning process compared to women. Some studies also referred to the gender gap in the use of computers, mobile phones, and internet, which is more common in developing countries than in developed countries. These differences can be observed depending on age, residence, culture, and use of mobile phones. In addition, patient satisfaction is influenced by individual, cultural, social, socioeconomic factors, health-related factors, past service experiences, and method of education.⁴⁶ Therefore, considering the above-mentioned factors, it seems that PD method is more popular among women than men and therefore they are more satisfied with the information received through this method.

One our study limitations was that all questionnaires were completed by patients previously referred to the clinic via telephone. Therefore, to overcome this limitation, equal number of patients were assigned into the two groups ($n = 10$ patients per group). In addition, since the researcher had no control over the accuracy of information recorded by the caregivers while reading questions to the patients, personal' views and opinions of caregivers may be included in the responses. Therefore, attempts were made to minimize the effect of this limitation on the research results by randomly allocating the research subjects into two groups and emphasizing on the need to record the patient's responses in the questionnaire. In the present study, patients were studied as inpatients and outpatients; therefore, it is recommended to evaluate the effectiveness of interventions based on the type of referral in

future studies. Also, the patients' baseline information regarding CAD was not assessed or considered as an inclusion or exclusion criterion.

5 | CONCLUSION

The results of the present study revealed that the usability of SPBD method was as the same as the PD method, as the most common educational material used since long time ago, in delivering educational materials. Therefore, it can be concluded that SPBD has the potential to be used in CAD patient education in Iran. It can also probably produce more medication adherence than the printed method. Higher information satisfaction was also reported in the SPBD group than the PD group, indicating high acceptability of this method among Iranian CAD patients.

AUTHOR CONTRIBUTIONS

Fahimeh Nikraftar: conceptualization; methodology; writing—original draft; writing—review & editing. **Fatemeh Heshmati Nabavi:** conceptualization; methodology; project administration; supervision; writing—original draft; writing—review & editing. **Mostafa Dastani:** conceptualization; investigation; writing—original draft. **Seyed Reza Mazlom:** formal analysis; investigation; methodology; writing—original draft. **Seyedmohammad Mirhosseini:** investigation; writing—original draft; writing—review & editing.

ACKNOWLEDGMENTS

This article is extracted from a medical-surgical nursing thesis, registered in the Iranian Registry of Clinical Trials (IRCT20180903040938N1) and approved by the Deputy of Research at Mashhad University of Medical Sciences of Medical Sciences. The authors would like to express their gratitude to the participants and their families for cooperation in this study. The research council of Mashhad University of Medical Sciences funded this study (970614).

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

TRANSPARENCY STATEMENT

The Fatemeh Heshmati Nabavi affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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How to cite this article: Nikraftar F, Heshmati Nabavi F, Dastani M, Mazlom SR, Mirhosseini S. Acceptability, feasibility, and effectiveness of smart phone-based delivery of written educational materials in Iranian patients with coronary artery disease: a randomized control trial study. *Health Sci Rep.* 2022;5:e801. doi:10.1002/hsr2.801