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Original Article

The effect of short message service (SMS) on knowledge and preventive behaviors of diabetic foot ulcer in patients with diabetes type 2

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ABSTRACT

Objective: The present study aimed at evaluating the effectiveness of an educational intervention via mobile cells on foot care knowledge and foot care practices in patients with type 2 diabetes.
Material and methods: This is an interventional quasi-experimental study carried out in 4 community health centers in Andimeshk City in Iran in 2017. Of 160 patients 80 cases were randomly assigned as intervention group and 80 patients as the control one. A three-section questionnaire completed by a face-to-face interviewing used for data collection before and after the intervention and three months after the education. Fasting Blood Sugar (FBS) and Hemoglobin A1C (HbA1c) tests were done for both groups in a single laboratory before and three months after training.
Results: The mean age of patients in intervention group was 48.11 ± 9.7 and control group was 47.3 ± 7.9 years. The awareness of the patients related to diabetes foot care, in the intervention group after the training significantly improved ($P < 0.001$). The mean scores of preventive behaviors of diabetic foot significantly increased in the intervention group ($P < 0.001$).
Conclusion: The findings indicate that educational intervention based on short message service (SMS), resulting in improve foot care knowledge, foot care practices and metabolic control in patients with diabetes type 2.

1. Introduction

Diabetes as the most common chronic disease in the world [1], remaining one of the most challenging issues of global health [2]. According to the International Diabetes Federation (IDF) in 2015, about 415 million people globally diagnosed with diabetes, which is predicted to reach 642 million in 2040 [3]. It is also estimated that the number of diabetic patients in Iran will reach 6 million by 2030 [4].

Diabetic foot ulcer (DFU) and its complications are common and serious complications of diabetes. About 60–70% of patients with diabetes develop peripheral neuropathy and lack of sense in feet, and approximately 15% of them will develop a foot ulcer during their course of the disease [5]. In the absence of control, the infection of the diabetic foot ulcer causes an impairment of amputation [6].

Each year, 4 million people in the world suffer from diabetic foot ulcer. In every 30 s, one person lose his or her feet due to diabetic foot ulcer. More than 70% of foot amputation in the world are found in diabetic individuals [7]. The prevalence of diabetic foot ulcer in Iran is estimated at 20%, and the rate of foot amputation estimated to be as 30.6% [8].

Diabetic foot care and treatment is costly: in developed countries, 20% of all health supplies are spent on taking care of diabetic

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foot. However, in developing countries, this rate is sometimes up to 40%. In addition to the high economic cost of diabetic foot, the burden of the disease is also high [9]. According to the WHO report, education is the basis of diabetes care [10].

Suitable training can reduce the complications of diabetes up to 80% [11]. According to studies, the application of educational strategies is the most important way to prevent foot ulcer infection in diabetic patients. If patients receive more information about their illness through training, they can participate more effectively in their treatment [12]. Training in diabetics is important, such as medication, exercise, and diet, because treatment is effective if the patient is well aware of the nature of the disease and takes positive steps to cope with it [13]. Improving knowledge of foot care and daily foot care are important steps in prevention of diabetic ulcers, although the education alone didn't decrease the incidence of diabetic foot ulcers and amputation [14].

Studies also show that using new training techniques may be more effective than traditional education systems [15]. Mobile technologies play an important role in the promotion and transfer of knowledge and information in practice [16]. Because of its widespread use and access everywhere, a mobile cell can be used as a choice in education [17]. One of the mobile phone services is Short Message Service (SMS) [18]. SMS has the potential to affect people's behavior due to their effectiveness, low cost, and the ability to disseminate health information to out-of-reach populations [19]. SMS is now used in various health care settings so that patients with chronic illness can be successful in their care [20] and control their illness [16]. Many studies have examined and validated the effectiveness of using SMS in people with diabetes [21,22].

Considering the widespread use of mobile phones, it seems that this device can be used as an effective way of communication in healthcare. The aim of this study was to evaluate the effect of training using mobile SMS (SMS) on knowledge and preventive behaviors of foot ulcer infection in patients suffering from type 2 diabetes.

2. Methods

The study employed an interventional quasi-experimental research design. The study population consisted of patients with type 2 diabetes, who referred to community health centers of Andimeshk City(located in Khuzestan province, south western of Iran) in 2017.Four of 8 community health centers were randomly selected: patients of two of the centers were selected as intervention group and patients in two other centers were selected as the control group. Then, 160 diabetic patients were randomly assigned into two groups: the intervention group ($n = 80$) and the control one ($n = 80$)(Fig. 1).

Inclusion criteria included: being over 30 years old, passing through at least 6 months of diagnosis of type 2 diabetes, no history of diabetic foot ulcer, willing to participate in the study, having the ability to use mobile phones and the ability to use text messages, being treated, not to be trained about foot ulcers. The exclusion criteria included not being interested in participating in the study, suffering from severe psychiatric and cognitive problems, taking insulin therapy, having any major diabetes complications (i.e., proliferative retinopathy, cardiovascular disease and lower limb amputation), and failing to attend one or more of the three educational sessions.

Both groups were referred to a single lab before and three months after training to perform Fasting Blood Sugar (FBS) and Hemoglobin A_1C (HbA_1c) tests.

The data collection instrument was a three-section questionnaire completed by a face-to-face interviewing method and immediately before and after the intervention as well as three months after the intervention. The first section deals with demographic characteristics (age, gender, marital status, education level, occupation, and diabetes duration), the second section contains 20 four-choice questions measuring the awareness of the subjects about the preventive behaviors of DFU. Awareness questions were scored as “Yes” (1 point), “I have no idea and No” (0 points) at a range of 0–20.

The third section of the questionnaire included 15 questions about preventive behaviors from the DFU. Scoring was done based on the 4-point Likert scale, ranging from “Never = 0” to “Always = 4”.

Educational intervention was performed on the intervention group and the control group, received only routine training. In the educational intervention, after receiving the mobile phone number of the patients in the test group, the same day, at the same time, the same messages were received regarding the preventive behaviors of the DFU(daily check feet for cuts, redness, sores, ulcers and blisters, daily washing and drying feet, using moisturizing creams to protect foot from drought, using shoes and cover properly for feet, properly trimming toe nails, not cutting off the edge of toe nails, not tampering with the warts and crests, and visiting physicians regularly).

Within 3 months 90 text messages were sent as a message per day for each patient in the intervention group. The maximum size of each message contained 160 characters. They were asked to pay attention to these texts, read them, and run them. If more than two messages were not sent to someone, they contacted him or her with the fixed number and the cause was requested and, if necessary, another number was taken from him or her. Patients were followed up for three months after the training to maintain their behaviors.

The validity of this questionnaire was confirmed by 10 experts via the content validity method. Reliability of the questionnaire was also confirmed by calculating the Cronbach's alpha coefficient as 0.81.

Data were analyzed via tests including descriptive statistical tests, Chi-square, independent *t*-test, paired *t*-test, and SPSS-18 software.

3. Ethics approval

The present research was approved with code IR.AJUMS.REC.1394.111 at the Ethics Committee of Ahvaz Jundishapur University of Medical Sciences.

4. Results

Participants consisted of patients aged 38–44 years. Of the 160 participants, 80 were randomly assigned in the intervention group and 80 were in the control group. The mean age of patients in intervention group was 48.11 ± 9.7 and control group was 47.3 ± 7.9 years.

There was no statistically significant difference between the two groups in terms of demographic characteristics such as age, gender, marital status, educational level, employment status and diabetes duration (Table 1).

Table 2 illustrates that there was no significant difference between the mean score of awareness of diabetic patients in intervention and control groups before education ($P < 0.001$). However, the awareness of the patients in the intervention group after the training significantly increased ($P < 0.001$), whilst there was no significant difference in mean score of control group before and after the educational intervention ($P < 0.001$).

Moreover, the results of Table 2 show that before the intervention, there was no significant difference between the preventive

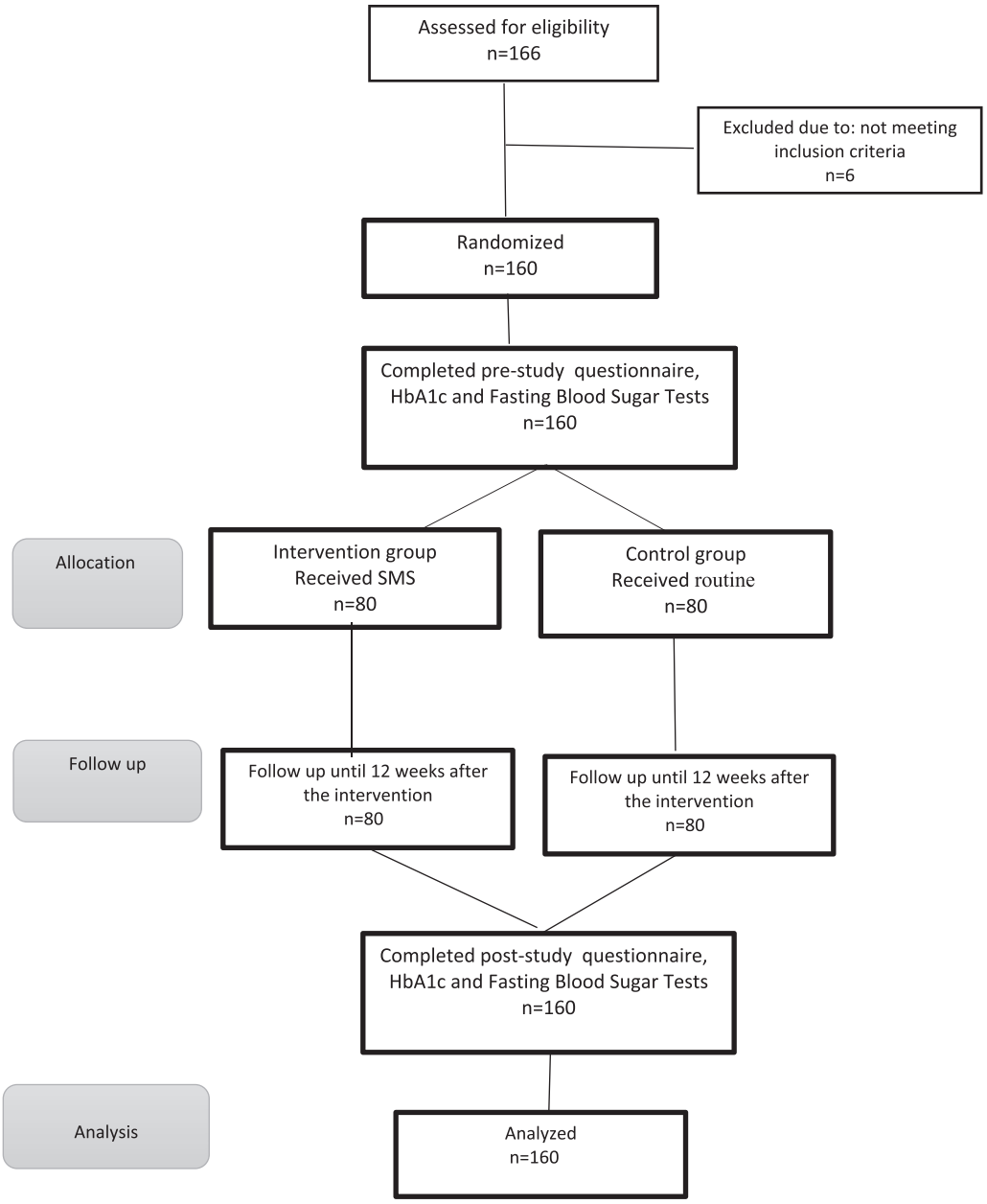

Fig. 1. Flowchart of the study.

Table 1
Comparison of demographic characteristics in the intervention and control groups patients with diabetes type 2.

Variable		Intervention group (Mean ± SD) or n (%)	Control group (Mean ± SD) or n (%)	p-value
Age (years)		48.11 ± 9.7	47.3 ± 7.9	0.385
Gender	Male	41(51.25)	37(46.25)	0.173
	Female	39(48.75)	43(53.75)	
Marital status	Married	71(88.75)	73(91.25)	0.582
	Single	9(11.25)	7(8.75)	
Job	Yes	60(75)	64(80)	0.674
	No	20(25)	16(20)	
Education level	≥ Diploma	69(86.25)	66(82.5)	0.860
	University graduate	11(13.75)	14(17.5)	
Duration of Diabetes	<5 years	33(41.25)	38(48.5)	0.282
	≥5 years	47(58.75)	42(52.5)	

Data are expressed as number (%) and mean ± SD.

Table 2
Comparison of knowledge and practice of diabetic foot care between groups before and after the intervention.

Variable	Time of study	Intervention group Mean ± SD	Control group Mean ± SD	p-value[a]
Knowledge of diabetic foot care	Before the Intervention	11.21 ± 4.23	10.90 ± 5.61	0.668
	After the Intervention	16.13 ± 6.32	11.42 ± 5.83	<0.001
	p-value[b]	<0.001	0.089	
Practice of diabetic foot care	Before the Intervention	38.50 ± 10.7	39.46 ± 9.30	0.922
	After the Intervention	54.28 ± 8.61	41.76 ± 9.86	<0.001
	p-value[b]	<0.001	0.541	

[a] Independent *t*-test.
[b] Paired *t*-test.

behaviors of the DFU in the intervention and control groups before intervention ($P < 0.001$). The mean scores of preventive behaviors of DFU before and 3 months after the intervention was significantly increased in the intervention group ($P < 0.001$), while such an increase was not observed in the control group ($P < 0.001$).

Based on the results before the educational intervention, the mean scores of FBS in the intervention group was 239 ± 96 mg/dL and in the control group was 221 ± 102 mg/dL, which were not statistically significant ($P < 0.001$). After the educational intervention, the mean scores FBS in the intervention group was 180 ± 74 mg/dL and in the control group was 226 ± 93 mg/dL there was a significant difference between the two groups based on Independent *t*-test ($P < 0.001$). Based on Paired *t*-test, there was a significant difference between the mean scores of FBS before and after the intervention in the intervention group ($P < 0.001$), but there was no significant difference in the control group ($P < 0.001$) (Table 3). The findings showed that there was no significant difference in mean HbA1c level between intervention group and control group before the intervention ($P < 0.001$).

There was a significant difference in the average level of HbA1c before and after the educational intervention in the intervention group ($P < 0.001$). However, this difference was not observed in the control group ($P < 0.001$) (Table 3).

5. Discussion

Education is the first part of foot care in people with diabetes who should be regularly warned about the adverse outcomes of the infection and they are asked to take preventive measures to prevent such infections [13]. Therefore, preventing diabetic foot ulcers requires awareness of patients [23]. Poor awareness of foot care is directly related to foot ulcer in diabetic patients [24]. Informing and educating these patients about proper care of the legs are two main issues [25]. Obviously, promoting a person's knowledge, attitude and skill in different levels of prevention in order to achieve self-care, will improve quality and quantity and also cut or decrease his dependence on others [26]. Also, knowledge of risk factors is a key factor in changing behavior [27]. The present study indicated that educational text messages improved the awareness of the patients in the intervention group.

These findings are consistent with the results of studies conducted by Monami, Marwa, Bin Abbas and Zareban [28–31]. Fatehi reported that teaching diabetic patients through text messages for 45 days increased their awareness of their illness [32]. In the present study, the increase in the awareness scores of the intervention group is significant because awareness is an introduction to behavioral changes in health education programs [33]. Therefore, given that foot care is simple and not cost-intensive, it seems that providing training to increase patient participation in self-care can help prevent DFU and cost a lot in the health system [34].

In the present study, the DFU preventive behaviors were evaluated with questions about daily blood glucose control, diet, regular exercise, regular use of medication and foot care (daily investigating feet in terms of ulcers and blisters, daily washing and drying feet, using moisturizing creams to protect foot from drought, using shoes and cover properly for feet, properly trimming toenails, not cutting off the edge of toenails, not tampering with the warts and crests, and visiting physicians regularly).

According to the WHO, diabetes education is at the heart of diabetes care and is a key to changing people's behaviors and promoting self-care. Diabetes education involves providing the necessary tools and support for patients to learn how to manage their illness [35].

Approximately 50–80% of diabetic patients do not have the skills to take care of themselves [36]. Bandura says that behaviors are the strongest source of information sufficiency because they are directly derived from expert experiences. By implementing behaviors, individuals develop and correct skills that are critical to continuous behavior [11].

In this study, the mean scores of DFU preventive behaviors in the intervention group after the intervention was significant, but there was no significant difference in the control group. In a study by Piette, self-monitoring of feet was significantly improved in patients with diabetes after 12 months [37].

In Kafaie's study, the mean scores foot care increased significantly after training [38]. Also Lincoln et al. [39] suggested a positive effect of educational intervention on self-care behaviors in diabetic patients, which confirms the results of the present study.

Because one of the important risk factors for complications of diabetes, including foot ulcers, is the lack of control of blood glucose [40], in this study, FBS and HbA1c were measured in both groups before and after intervention. Hyperglycemia is a modifiable risk factor for diabetic neuropathy; proper blood glucose control is the most effective proven treatment to reduce the incidence and

Table 3
Comparison of mean HbA1c and FBS levels in both groups before and after the intervention.

Variable	Time of study	intervention group Mean ± SD	Control group Mean ± SD	p-value*
FBS mg/dL	Before the Intervention	239 ± 96	221 ± 102	0.410
	After the Intervention	180 ± 74	216 ± 93	0.026
	p-value**	0.007	0.690	
HbA1c(%)	Before the Intervention	8.56 ± 1.65	8.52 ± 1.57	0.792
	After the Intervention	7.39 ± 1.44	8.54 ± 1.81	<0.001
	p-value**	<0.001	0.741	

progression of diabetic neuropathy and improve the quality of life of patients [41].

Daily and continuous blood glucose monitoring is the basis of diabetes control [42]. Today, measuring HbA1c as a gold standard is acceptable for long-term control of glucose control, and its rate is an appropriate indicator for assessing the average blood glucose concentration over the past two to three months [11]. Previous studies have shown that if the level of HbA1c is increased by 2%, the risk of developing the ulcer is 1.6 times greater and the chance of an amputation is 1.5 times higher [43].

The results of the present study indicate that three months after the intervention, the mean scores of HbA1c had a significant decrease in the intervention group. While changes in control group were not significant. In addition, there was a significant change in FBS in the intervention group as compared to the control group after the intervention. The results of the study by Bin Abbas et al. showed a significant decrease in FBS and HbA1c in the intervention group after the intervention. These results confirm the findings of the present study [31].

In a study done in Indonesia on diabetes patients, Rusdiana et al. showed there was a significant decrease in the level of FBS and HbA1c in the intervention group [44]. Goudarzi et al., in a study titled as “investigating the effect of education through SMS on self-efficacy and HbA1C in patients with type 2 diabetes”, showed that the mean scores of HbA1c in the intervention group after the intervention significantly decreased. Therefore, the findings of this study indicated the optimal effect of educational SMS using mobile capabilities [45]. Zareban [29] and Zibaeenejad M J [46] and Mubashira Butt [47] also achieved similar results.

The findings revealed role of educational intervention using short message service (SMS) on improvement of foot care awareness, foot care behaviours and metabolic control in patients with diabetes type 2. Further studies are needed for compare of foot ulcer occurrence between 2 groups.

Conflicts of interest

There is no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dsx.2019.01.051.

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