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Azadeh Hajipour[1], Maryam Javadi[2], Isa Mohammadi Zeidi[3]

[1]Student Research Committee, Qazvin University of Medical Sciences, Qazvin, Iran
[2]Children Growth Research Center, Research Institute for Prevention of Non-Communicable Diseases, Qazvin University of Medical Sciences, Qazvin, Iran
[3]Health Products Safety Research Center, Qazvin University of Medical Sciences, Qazvin, Iran

The Effect of Stage-Matched Educational Intervention on Behavior Change and Glycemic Control in Elderly Patients with Diabetes

ABSTRACT

Objective: Diabetes is a chronic and common global disease that requires particular care behaviors for the rest of life. People with diabetes can be trained to achieve optimal self-care. The present study was conducted to determine the effect of stage-matched educational intervention on behavior change and glycemic control in elderly patients with diabetes.

Matherials and methods: In this controlled clinical trial, 110 type 2 elderly patients with diabetes were selected randomly from health centers in Malard city, Iran, and were assigned to the control and experimental group equally. Data collection instruments were: demographics questions, scales to assess transtheoretical model constructs and stage of change, and blood samples for determining FBS and HbA1c. The mentioned variables were measured before, 1, and 3 months after the stage-matched educational intervention. The educational intervention consisted of 2 group intensive training sessions of about 45 minutes and daily messages via mobile phone for 3 months. The educational topics were about healthy diet and caring behaviors. Data were analyzed using SPSS 25.0 and independent & paired t-test, chi-square, one-way ANOVA, and ANCOVA. The significance level was considered less than 0.05.

Results: The mean age of study participants was (66.5 ± 3.91) years. Also, the average duration of diabetes was (7.18 ± 4.21) years, and 50% had a Junior high school education. A significant decrease was found in mean FBS (from 187 ± 43.4 to 136.42 ± 36.34, $p < 0.05$) and HbA1c (from 8.28 ± 1.26 to 7.26 ± ± 1.10, $p < 0.05$) in the experimental group, and also the mean of self-care behaviors in the experimental group increased significantly from baseline (from 1.51 ± ± 1.71 to 1.45 ± 0.92, $p < 0.05$).

Conclusions: Educational intervention based on the stages-of-change model can improve glycemic control and behaviors related to controlling diabetes, so it is necessary to pay attention to essential psychological variables in designing educational interventions in order to control blood glucose in patients with diabetes.
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Keywords: diabetes mellitus, glycemic control, education, stage of change model, health behavior

Introduction

The world's population is rapidly aging [1], and the prevalence of chronic diseases such as diabetes as well as the period and cost of care will increase [2].

Address for correspondence:
Isa Mohammadi Zeidi, Associate Professor
Health Products Safety Research Center,
Qazvin University of Medical Sciences, Qazvin, Iran
phone: +989124146500
e-mail: easamohammadizeidi@gmail.com
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According to the International Diabetes Federation, the global prevalence of diabetes will increase to about 439 million by 2030, with 69% of this increase occurring in developing countries [3]. According to this organization's 2017 report, the number of people with diabetes in the Middle East will increase by about 72% by 2045, in which Iran will become one of the most prevalent regions in the Middle East and the world in terms of diabetes by 2030 [4]. Diabetes results from impaired insulin secretion, insulin function, or both and causes impairing the metabolism of carbohydrates, fats, and proteins [5]. Type 2 diabetes is caused by the interaction of environmental and genetic factors, such as aging, high body mass index, lack of physical activity, and unhealthy diet, which increase the risk of type 2 diabetes [6]. Diabetes management and treatment include nutrition therapy, medication, and exercise, and people with diabetes should play an active role in their treatment process [7]. In developing countries where diabetes treatment costs are rising, self-care skills training can reduce costs and improve treatment outcomes [8]. Also, increasing the awareness of patients and the community about self-care skills improves drug use, glycemic control, and diet management [9]. The effectiveness of training in health education is depended on the proper use of theories and models [10]. Stages of change theory are one of the most widely used educational models in which the modification of behavior or adoption with a positive attitude is emphasized [11]. The main hypothesis of this model is that behavior does not occur spontaneously and randomly but occurs during a series of stages [12, 13]. During the changing process, the importance of the advantages and disadvantages of changing behavior is considered, and interventions following this model have been more effective than other theory-based interventions [14].

Due to limited evidence on using educational programs in elderly patients with diabetes [15, 16], the present study aimed to determine the effect of an intensive training program based on the theory of stages of change on health behavior and glycemic control in the elderly patients with type 2 diabetes.

Materials and methods

Type of study

This randomized controlled trial (RCT) study with before and after measurement was conducted in 2018––2019 in Malard City, Iran.

Participants and sampling process

The study population included all elderly patients with type 2 diabetes (T2D) who were covered by regular health services from Mallard Health Care Centers (A total of 5 health care centers) and were willing to participate in the current research voluntarily. The total number of T2D patients covered by health centers was 278, and by using the multi-stage sampling method 110 patients with type 2 diabetes were included in the study based on inclusion and exclusion criteria and divided into two groups of 55 control and intervention. Due to the same number of patients covered by each center, 22 patients were randomly selected from each of the centers — using a random number table — and were allocated to control and experimental groups via lots drawing method. The method of assigning patients to experimental and control groups is shown in CONSORT Diagram (Fig. 1). Inclusion criteria for the cases were: age over 60 years, Iranian race, having type II diabetes and at least six months after diagnosis of T2D, has the ability to speak, read, and write texts in Persian, a history of type 2 diabetes medication treatment, living in Mallard City, No Grade II Diabetic Foot Ulcer based on Wagner criteria, and finally not receiving any nutritional education except the routine training of health care. Patients with secondary problems such as lack of appropriate physical condition to answer questions, cognitive problems, mental illness, and unwillingness to use digital or mobile media were excluded from the study.

After a full explanation of the research objectives, a team member obtained participants' written consent forms.

Data collection instruments

The required data were collected as follows:

Demographic characteristics

A) Information on age, sex, height, weight, body mass index, history of diabetes, type of drug used, marital status, economic status, and the level of education were collected using a self-report questionnaire.

Clinical variables

B) In this study, in addition to routine measurement of fasting blood sugar (FBS) in elderly patients with diabetes after 8–12 hours of fasting, glycosylated hemoglobin (HbA1c) was also measured because it is a specific indicator for evaluating self-care activities and blood sugar [17]. The colorimetric measuring method for HbA1c releases glucose in 100°C as 5-hydroxymethylfurfural (5HMF) and then measures it in a colorimetric reaction with thiobarbituric acid (TBA). Also, fasting blood glucose levels were measured by a procedure based upon the enzyme glucose oxidase.

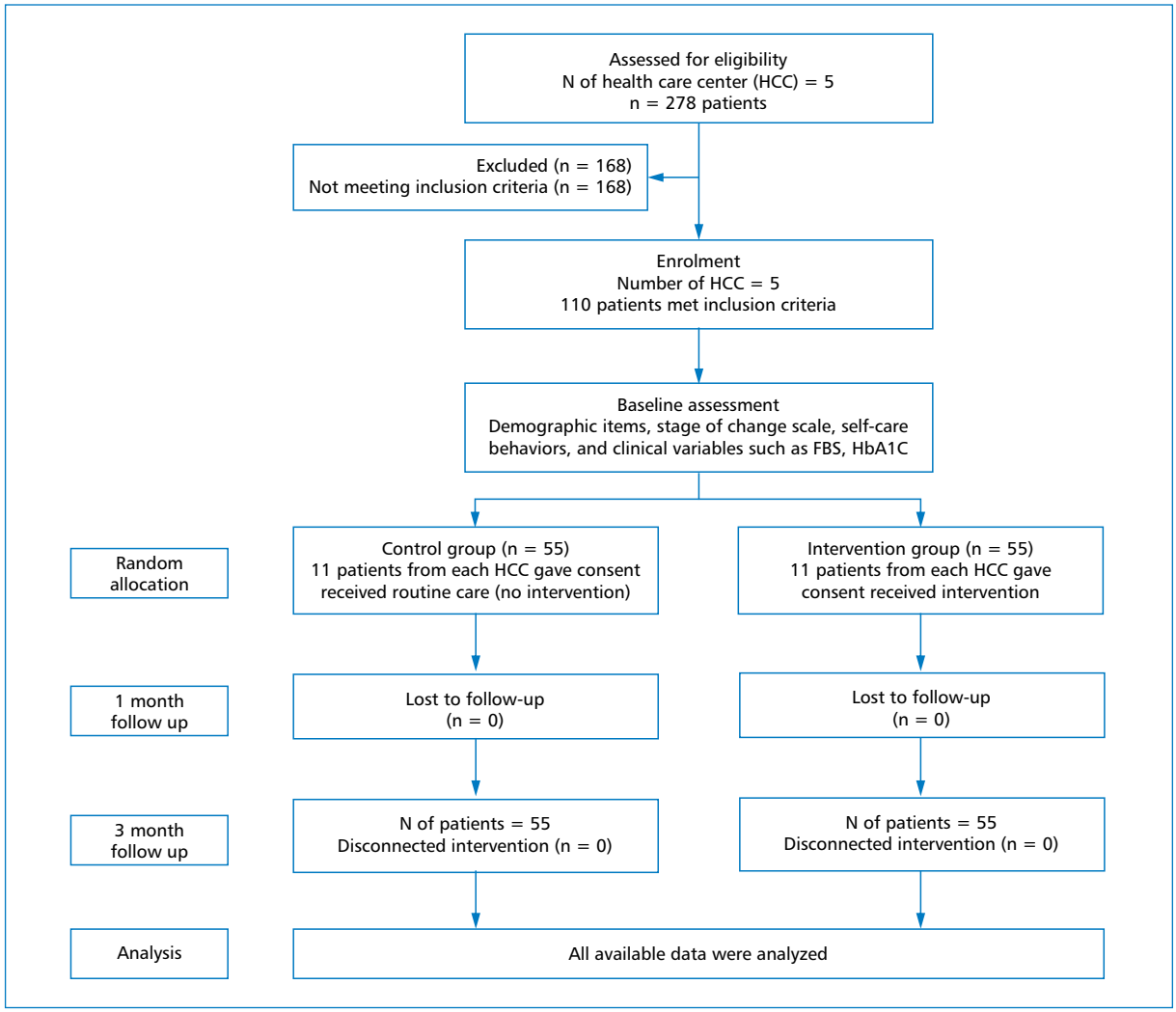

Figure 1. Consort Trial Flow Chart

Stage of change scale

C) Behavior change stages algorithm: It has one question about the behaviors of physical activity, medication use, foot care, and diet. Participants were asked to answer this question by selecting one of the five options. If the patient chooses "I have control of my diabetes completely for more than six months", they will be placed in the maintenance phase. If it selects the option "I have made changes to my care behaviors in the last six months", it will be in the Action phase. If the patient selects the option "I intend to make changes in my caregiving behaviors within the next 30 days", it will be in the preparation phase. If the option "I intend to make changes in the next six months" was selected, it will be in the contemplation phase. Finally, if the patient chooses "I have no interest or plan to change my diabetes care behaviors", they will be in the pre-contemplation stage [18]. The behavior change stages algorithm questionnaire has been used extensively in domestic and foreign studies, and its psychometric properties have been confirmed [19–21].

Data collection process

The required data were collected using questionnaires and blood samples in three basic stages, one month and three months after the educational intervention.

This research was approved by the Research Ethics Committee of Qazvin University of Medical Sciences, Qazvin, Iran (code IR.QMS.REC .1397.006).

Educational intervention and education session contents

The intervention group was divided into two groups. Then, each group participated in two face-to-face training sessions for 45 minutes on two con-

secutive days. In the first session, the definitions of hormonal function, the mechanism of diabetes and its cause, and the role of nutrition in the incidence and control of diabetes were taught by lecture method and using a video projector. Also, in the second session, methods of controlling diabetes (with emphasis on nutritional methods) and the consequences of lack of control were trained.

After finishing the educational sessions, encouraging and supportive text messages were sent to the intervention group, which included the following topics: healthy eating in old age, the correct way to measure the sugar content of different foods, how to select and distribute carbohydrate sources throughout the day properly, Nutritional tips to prevent and control the symptoms of hyper and hypoglycemia, threats and consequences associated with uncontrolled diabetes, the correct method of measuring blood sugar, proper exercise for patients with diabetes and the correct method of foot care. A daily message was sent to each person in the intervention group for three months.

To ensure that the patients read the messages, it was decided that they inform the researcher with the answer "received" or "make a phone call". If more than three messages were not sent or remained unanswered, the patient was contacted, and the cause was determined.

Statistical analysis

The obtained data were analyzed using SPSS software version 25. The data distribution was examined using the Kolmogorov-Smirnov test in terms of normality. Then, the Chi-squared and the independent t-test method was used to compare the variables between the two independent group. One-way analysis of variance (ANOVA) was used to compare the mean score of a variable between three independent groups and more (e.g., to compare, for example, comparing the mean of HbA1c between patients with different levels of education), and the Repeated Measure ANOVA was used to examine the change in the mean score of a variable at different times (for example, comparing the mean of FBS in the experimental group at baseline, one and three months after the intervention). The significance level was considered less than 0.05 in the current research.

Ethical approval

This study is a master's thesis that has been done by obtaining the necessary licenses from Qazvin University of Medical Sciences, the Vice-Chancellor for Health of Qazvin University of Medical Sciences, and Qazvin Health Centre. (Ethics code: IR.QMS.REC .1397.006)

Results

In the present study, the distribution of the measured variables in the two groups was normal. No significant difference was found between the experimental and control groups at baseline. The mean age of study participants was (66.5 ± 3.91) years. Also, the average duration of diabetes was (7.18 ± 4.21) years, and 50% had a Junior high school education. Other information is provided in Table 1.

Table 2 compares the mean of FBS, HbA1c, and self-care behaviors at baseline, one and three months between control and experimental groups after the stage-based educational intervention.

The repeated measures analysis of variance showed a significant difference between the mean FBS of patients in the experimental group one and three months after training ($p = 0.001$). In contrast, the mean of FBS in the control group at different stages did not show a significant difference. A significant decrease in the mean HbA1c of the experimental group was found after three months of the intervention ($p = 0.001$). No significant change was observed in the mean in the control group.

The independent t-test in the basic stage showed that there was no significant difference between the two groups in terms of the desired variable. However, one month after the educational intervention, we saw a significant difference in the mean of self-care behaviors between the experimental and control groups ($p < 0.001$). Also, the repeated measures ANOVA showed that the mean of self-care behaviors in the experimental group was statistically different between the three-time periods ($p = 0.003$) or in other words, the mean of self-care behaviors in the experimental group increased significantly from baseline to one month after the educational intervention ($p = 0.003$).

Discussion

The present study was performed on 110 elderly patients with type 2 diabetes living in Tehran province. The results showed that FBS and HbA1c levels in the experimental group were significantly decreased after the educational intervention. Our results are in line with studies of Mahdi et al. and Chrvala et al., which showed that Educational interventions for the elderly patients with diabetes have significantly reduced HbA1c and FBS [22, 23]. Another important result in this study was the intensity of training sessions and their effect on blood biochemical parameters. As observed in previous studies, intensive training sessions can replace long-term ones [24, 25].

The primary purpose of education for people with diabetes is to help them make informed decisions and improve self-care behaviors, and as many studies

Table 1. Demographic and Anthropometric Characteristics of the Experimental and Control Groups

Variables	Sub classes	Control group (n = 55) N (%)	Experimental group (n = 55) N (%)	Significant level
Gender *	Male	(38.2) 21	(40.0) 22	p = 0.5
	Female	(61.8) 34	(60.0) 33	
Type of medication *	Tablet	(76.4) 42	(63.6) 35	
	Insulin injection	(3.6) 2	(7.3) 4	p = 0.328
	Insulin pills	(20.0) 11	(29.1) 16	
Marital status *	Single	(1.8) 1	(1.8) 1	
	Married	(70.9) 39	(63.6) 35	p = 0.685
	Widow	(27.2) 15	(32.7) 18	
	divorced	(0.0) 0	(1.8) 1	
Economic situation *	Weak	(32.7) 18	(32.7) 18	
	medium	(54.5) 30	(54.5) 30	p = 0.972
	Good	(12.7) 7	(12.7) 7	
Education level *	Primary	(25.5) 14	(20.0) 11	
	Junior high school	(49.1) 27	(47.3) 26	p = 0.696
	High school	(16.4) 9	(26.3) 13	
	Diploma	(7.3) 4	(9.1) 5	
	University	(1.8) 1	(0.0) 0	
		Mean ± SD	Mean ± SD	
Height (metres)		1.68 ± 0.099	1.67 ± 0.098	p = 0.701
Weight [kg]		78.13 ± 15.67	77.68 ± 14.85	p = 0.877
BMI [kg/m^2]		27.73 ± 4/97	27.83 ±4.66	p = 0.917
History of diabetes (year)		7.14 ± 3.78	7.23 ± 4.56	p = 0.912
Age (year)		66.47 ± 3.82	66.51 ± 4.04	p = 0.961

*Chi-square test

have shown, behavioral interventions that use specific educational theory make better clinical results [10, 26]. In agreement with our findings, the evidence from an extensive systematic review of studies revealed that educational interventions based on stage matched education are effective in reducing HbA1c, creating positive health behaviors, and preventing chronic diseases such as diabetes [18, 27].

One of the most important reasons frequently mentioned for the failure of educational interventions in elderly patients with type 2 diabetes is the lack of access to health services and the lack of use of new technologies [28, 29]. In this regard, our findings showed that by removing these barriers and following patients through sending daily educational text messages and thus increasing their access to health services, long-term benefits could be expected. The study of Abbas et al., which was a prospective nonrandomized experimental trial study, showed that daily mobile phone text messaging for four months increased diabetes self-management and improved the FBS and HbA1c outcomes in Saudi patients with type 2 diabetes [29]. Furthermore, Ortiz et al., in the systematic review study, proposed using text messages in the management of type 2 diabetes is a suitable, practical, and well-accepted technology, and it has strong potential for providing effective, ongoing support in the future. Also, reliable information and effective communication are both essential elements in health care, and the use of appropriate technology such as mobile phones, in fact, increases the quality and accessibility of both elements [30].

Our study has several strengths; this study is the first one to simultaneously examine model-based educational intervention and the use of technology on behavior change and glycemic control in elderly patients with diabetes type 2. Also, we used intensive educational sessions instead of long-term ones. Along with the strengths, our study has several limitations. First, because of collecting some of the data through the self-reporting method, recall bias cannot be avoided. Second, it is not possible to generalize our results to the whole elderly population by limiting participants' selection to diabetic elderly just who had the ability and interest to use mobile phones.

Table 2. Comparison of Mean of FBS, HbA1c and Self-Care Behaviors at Baseline, One and Three Months after the Educational Intervention between Two Groups

Variables	Time	Control group (n = 55) Mean ± SD	Experimental group (n = 55) Mean ± SD	Significant level p-value
FBS (mg/dL)	At baseline	186.18± 48.06	187.98± 43.4	0.837
	After one month	190.47± 59.94	158.89± 38.79	0.000
	After three months	187.18± 45.36	136.42 ± 36.34	0.000
	P** between three times	p = 0.283	p = 0.000	
HbA1c (%)	At baseline	8.42 ± 1.29	8.28± 1.26	0.567
	After one month	8.27± 1.15	7.92± 1.22	0.123
	After three months	8.29± 1.18	7.26± 1.10	0.000
	P** Between three times	p = 0.136	p = 0.000	
Self-care behaviors	At baseline	1.47 ± 1.61	1.51 ± 1.71	0.909
	After one month	1.13 ± 1.53	2.16 ± 1.32	p < 0.001
	After three month	1.38 ± 1.60	1.45 ± 0.92	0.770
	P** Between three times	p = 0.309	p = 0.003	

**; Test, analysis of variance with repeated measures

Conclusions

In general, self-care and glycemic control in elderly patients with type 2 diabetes was significantly improved after an intensive training program based on stage-matched educational intervention. So, a focus on educational models in the design of therapeutic interventions in elderly people with diabetes can be recommended. Further studies with more comprehensive methods are needed to confirm using new technologies and educational models for the improvement of health status in elderly patients with diabetes.

Conflict of interest

None declared.

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