The Effect of an Educational Intervention Based on the Theory of Planned Behavior (TPB) on Self-Care Behavior and Glycosylated Hemoglobin (HbA1c) Levels in Patients With Type 2 Diabetes

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Abstract

Background: The diabetics' lack of awareness about self-care and false beliefs in this care are the reasons for their admission to hospitals. The present study aimed to "determine the impact of using education based on the theory of planned behavior on self-care and glycosylated hemoglobin (HbA1c) levels in patients with Type 2 Diabetes".

Methods: The present quasi-experimental study examined 60 patients with type 2 diabetes who were randomly classified into intervention and control groups. In the intervention group, self-care education was held based on the theory of planned behavior. The data were collected using a three-part questionnaire consisting of demographic and clinical information, and questions about constructs of the theory of planned behavior, and the Summary of Diabetes Self Care Activities by Robert at three stages: pre-test, post-test, and follow-up.

Results: The mean scores of constructs of the theory of planned behavior, as well as self-care behaviors after the educational intervention (immediately and after three months), increased significantly in the intervention group compared to before the intervention and the control group. Furthermore, the mean amount of glycosylated hemoglobin in the intervention group was significantly lower than before the intervention and the control group three months after the educational intervention.

Conclusion: Education based on the theory of planned behavior was effective in improving the patients' self-care behavior and HbA1c index. Therefore, we suggest all medical centers use the theory of planned behavior as an effective educational model with easy and low-cost implementation power to improve diabetics' self-care behavior and health.

Introduction

Diabetes is the most common and important non-communicable chronic metabolic disease in the world. Diabetes occurs when the pancreas does not produce enough hormone insulin or the body becomes resistant to insulin, and the insulin cannot function normally in the body, leading to an increase in blood sugar levels in the body. Type 2 or non-insulin-dependent diabetes is the most common type of diabetes (1). In type 2 diabetes, there is a progressive body resistance to insulin, which may eventually lead to the destruction of pancreatic beta cells and a complete defect in insulin production, and it is also known as insulin-resistant diabetes (2, 3).

The most important risk factors for type 2 diabetes are obesity, high cholesterol, high blood pressure, and inadequate physical activity (4). According to the latest statistics reported by the World Health Organization (WHO), about 422 million people have diabetes worldwide, and 1.6 million deaths per year are directly attributable to diabetes (5). The number of these patients is projected to reach 640 million in the world by 2035, and 72 million in the Middle East and North Africa by 2040 (6).

Diabetics are at risk for retinopathy, neuropathy, cataracts, kidney diseases, foot ulcers, amputations, cardiovascular diseases, stroke, severe infections, and other serious complications (7). As mentioned, diabetic patients suffer more from physical, mental, and psychological complications than healthy individuals and are also involved in treatment costs and economic problems, affecting their quality of life (8).

Adopting self-care behavior is the safest and cheapest strategy to prevent and control health problems. Self-care behavior includes a set of actions that lead to the improvement or maintenance of a person's health. Self-care is often defined as prevention or treatment under health conditions and problems, but it can also be considered as a kind of primary prevention in the absence of any clinical symptoms (9). An important feature of self-care behavior is that it leads to active participation in the process of health care (10). The self-care behaviors in diabetes include proper and timely injection of insulin, adherence to diet, regular exercise, diagnosis of symptoms of hypertension or hypoglycemia, regular use of medications, and foot care (11).

Self-care is an important and basic strategy to control diabetes and can reduce readmission and prevent 85% of problems caused by this disease (12). Therefore, understanding the importance of self-care shows the need to design and implement a variety of interventions, including educational interventions about the promotion of self-care behaviors among diabetics (13). Failure to perform self-care behaviors has serious complications so that the lack of self-care is the most important cause of death in diabetics (14). Even though self-care protects people in society against many diseases, and its importance and value have been emphasized in scientific texts, many people, especially patients, do not admit it due to various factors, including people's lack of awareness about the concept of self-care, as well as misconceptions in this field. Therefore, identifying these factors and changing them increase the chance of adopting self-care behavior by people. The use of health education and promotion programs is a strategy in this regard.

The use of behavior change theories increases the likelihood of increasing the effectiveness of health education programs. Through models, we can measure the effects of educational interventions and even predict behaviors (15, 16). The Theory of Planned Behavior (TPB) is an important and appropriate theory of behavior change proposed by Ajzen and Fishbein in 1980 to predict and explain individual behavior. This theory assumes individuals as rational operators so that they process information before performing a behavior and it is possible that these assessments and basic beliefs consequently change their behavior (16). According to this theory, behavioral intention is the most important determinant of a person's behavior. Behavioral intention refers to thinking, preparing, making decisions, and being motivated to do something. According to the theory of planned behavior, the determinants of behavioral intention are the three factors, namely attitude, abstract norms, and perceived behavioral control (15, 16). Attitude means constructing a positive or negative mental attitude towards a behavior. Abstract norms refer to the influence and pressure from others to do or not to do the behavior, and the perceived behavioral control also refers to individuals' feelings about the extent of their ability to do the behavior (16).

Various studies have confirmed the effectiveness of the theory of planned behavior on self-care behaviors in people with chronic diseases, including diabetics (17, 18). Therefore, the present study aimed to determine the effect of an educational intervention based on the theory of planned behavior on self-care behaviors and glycosylated hemoglobin (HbA1c) levels in diabetics. The results indicated can provide a new horizon for healthcare providers, especially health educators, on the way of improving self-care behaviors and ultimately the health in diabetics.

Methods

The present research was a quasi-experimental pre and post-intervention controlled study that examined patients with type 2 diabetes under the coverage of Khoy Comprehensive Health Service Centers in 2020 after receiving the necessary licenses from the Ethics Committee and Deputy of Research and Technology at Urmia University of Medical Sciences and also obtaining the necessary consent and licenses from the Deputy of Health Affairs at Khoy University of Medical Sciences. Inclusion criteria of the study were as follows: patients with type 2 diabetes undergoing medication (prescribed by a specialist), with a history of at least 6 months and older, age of 30 to 70 years, having a minimum literacy, no severe physical and mental illness, no participation in similar research or training classes during the last 6 months, and having the consent to participate in the study. Exclusion criteria: Incomplete completion of questionnaires, absence in more than 1 session during 5 training sessions, unwillingness to continue cooperation, and the occurrence of an unfortunate event.

The sample size was equal to 21 per group according to results of the same studies (17), 95% confidence interval, 95% power, and using the sample size formula and comparing the two means (Pukak), and finally, 30 individuals per group were included in the study by taking into account a 30% possible drop. We used the multi-stage sampling method for sampling. First, Khoy city was divided into four geographical directions (north, south, east, and west), and then a comprehensive health service center (four centers in total) was selected as the cluster based on the cluster sampling method. Then, two centers were selected as the intervention group and the other 2 centers as the control group using the simple random sampling method. Then, 15 patients were selected and included in the study by a draw based on the simple random sampling method from each group and among the patients who met the inclusion criteria.

The data collection tool consisted of four sections. The first section consisted of demographic and clinical information, including age, sex, and marital status, and glycosylated hemoglobin (HbA1c) levels based on the result of the last test. The second section consisted of 11 researcher-made questions about awareness of different dimensions of diabetes (including symptoms, complications, treatment, and self-care behaviors). Possible answers to awareness questions were in three options (including yes, no, and neutral). The correct option received a score of 2, the neutral option received a score of 1, and the incorrect option received a score of zero. The minimum and maximum scores for this section of the questionnaire were equal to zero and 22. A high score indicated that patients were well aware of diabetes.

The third section of the researcher-made questionnaire was based on the constructs of the theory of planned behavior about self-care behaviors. The section consisted of 64 questions, of which 16 questions assessed the attitudes of research units towards self-care behaviors about diabetes. There were 16 questions about perceived abstract norms for self-care behaviors, 16 questions about perceived behavioral control for self-care behaviors, and 16 questions about the behavioral intention for self-care behaviors. We used a 5-point Likert scale to score the constructs of the theory of planned behavior, and the scores ranged from 5 (strongly agree) to 1 (strongly disagree). The minimum score was 64 and the maximum was 320. Obtaining a higher score in each construct indicated the participant's good status in terms of that construct.

The initial questions of the researcher-made questionnaire were designed based on the literature review and experts' opinions in fields related to research and instrumentation. We then measured and approved the validity and reliability of the questionnaire, and used face validity (qualitative and quantitative) and content validity (qualitative and quantitative) to determine the validity.

In the qualitative face validity method, we had face-to-face interviews with 10 patients in the target group, and obtained their opinions, and included them in the questionnaire. In the quantitative face validity method, we calculated the impact score of each question. To this end, we used a panel of experts and gave the questionnaires to 10 experts in disciplines related to research and instrumentation and asked them to give each question a score from 1 to 5 in terms of their importance. Questions with impact scores of greater than 1.5 remained in the questionnaire and were otherwise omitted (19).

We used the above-mentioned panel of experts to assess the qualitative and quantitative content validity. In the qualitative method, they were asked to write down their corrective views after a careful read of questions, and we finally obtained their opinions and included them in the questionnaires. In the quantitative method, we calculated the content validity ratio (using the criterion of necessity) and the content validity index (using the criteria of relevance, clarity, and simplicity). Questions with a content validity ratio of more than 0.62 and a content validity index of more than 0.79 were accepted (19).

We utilized the Cronbach's alpha coefficient to assess the reliability of the researcher-made questionnaire. Therefore, we gave the pilot questionnaire to 30 patients in the target group and calculated the Cronbach's alpha coefficient after completing the questionnaires. The Cronbach's alpha coefficient was above 0.7 for all constructs; hence, the reliability was optimal (19).

The fourth section consisted of the Persian version of the Summary of Diabetes Self Care Activities (SDSCA) by Robert et al. (20). The questionnaire was localized in Iran by Hamadzadeh et al. in 2013 (21). It was a self-report questionnaire consisting of 15 questions and examined the diabetics' self-care activities during the last seven days, and included various aspects of self-care, including general and specific diets, exercise, blood sugar testing, insulin injection, or taking anti-diabetic pills, foot care, and smoking. Except for smoking behavior on the scale, which was given a score of zero to 1, the rest of the questions were scored from zero to 7, depending on the number of days when a person performed desired self-care behavior during the past week. Finally, a total adherence score was obtained by summing the

scores obtained from each question so that the total score ranged from zero to 99 for the questionnaire. A higher score indicated the good condition of patients in terms of self-care behaviors (20, 21).

The questionnaires were completed by patients of intervention and control groups to determine their educational needs and design an educational intervention, and an educational program was designed based on the constructs of the theory of planned behavior according to the pre-test results. The training program was implemented in five 45-minute training sessions with special educational contents according to patients' needs in the intervention group in groups of 10 to 15 individuals and in accordance with the health protocols of COVID-19. Patients in the control group were not exposed to the educational intervention and received only their routine care.

In the first training session and after introducing and stating the program purpose, we presented generalities about the disease, including the definition of diabetes, types of diabetes, signs, symptoms, and complications of diabetes. The second session focused on ways to prevent and control diabetes, especially through non-pharmacological interventions. The session emphasized physical activity and the importance, consequences, and benefits of regular physical activity so that we could have a positive impact on individuals' attitudes towards this health behavior (physical activity). The third session briefly reviewed the content of previous sessions and emphasized the food groups and the number of calories created by them, especially the importance of a specific diabetes diet, and its effect on blood sugar control, as well as the benefits of changing meals in terms of volume and number. This session sought to increase patients' awareness about different dimensions of diabetes and changing patients' attitudes and behavioral intentions towards diet. In the fourth session, we used special strategies such as verbal persuasion and teaching self-care behaviors in small, simple, and applicable steps to increase the patients' self-efficacy and perceived behavioral control to perform self-care behaviors and thus increase their ability to perform such self-care behaviors without any sense of barriers (16).

The fifth session reviewed the previous content and emphasized the importance of other self-care behaviors and methods that helped control diabetes, such as self-control of blood sugar, and regular use of anti-diabetic drugs, continuous and regular care of feet, avoidance of smoking, and stress management. In the last education session, key and influential people on the patients, who were invited during the previous coordination, were intervened, and their importance and role in supporting patients to perform regular self-care behaviors were emphasized. In all training sessions, the health educator used a combination of teaching methods, both a direct interactive method (Q&A speech, and group discussion) and an indirect method, including the use of educational media such as educational pamphlets and disease-related booklets. The present study with an ethical code (IR.UMSU.REC.1399.231) was approved by the Ethics Committee of the deputy of Research and Technology at Urmia University of Medical Sciences. To observe ethical principles, we obtained informed consent from all participants in the study, and assured them that their information would be confidential after the study, and provided educational packages for the control group.

Statistical Analysis:

The data were analyzed in SPSS 22 using descriptive statistics (mean, standard deviation, percentage, and frequency), and analytical statistics, including Kolmogorov-Smirnov test (to examine the data normality), paired t-test, independent t-test, and ANCOVA. Our results were significant at a statistical level of $p<0.05$.

Results

In the study, we included 60 patients with type 2 diabetes in the study: 30 in the intervention group and 30 in the control group. The patients' mean age was 55.40±11.78 years in the control group, and 52.73±9.88 years in the intervention group. Table 1 shows the patients' demographic and clinical characteristics in the intervention and control groups. As shown in the table, the patient allocation process was designed in a way that the two groups were homogeneous in terms of demographic and clinical variables (Table 1).

The results of the independent t-test indicated that there was not any statistically significant difference between the intervention and control groups in terms of mean scores of all constructs of the theory of planning behavior at the pre-intervention stage, while the results of analysis of covariance indicated that mean scores of the constructs of the theory of planning behavior increased significantly in the intervention group compared to the control group immediately and three months after the educational intervention (Table 2).

The results of the paired t-test indicated that the mean scores of all constructs of the theory of planned behavior increased significantly in the intervention group immediately and three months after the educational intervention compared to the pre-intervention stage ($p<0.05$). In the control group, there was not any statistically significant difference in mean scores of the constructs before and three months after the educational intervention, while changes before and immediately after the educational intervention significantly decreased (Table 2).

The results of the independent t-test indicated that there was not any statistically significant difference between the intervention and control groups in terms of mean scores of total self-care behavior and its dimensions (except for blood sugar self-control) at the pre-intervention stage, while analysis of covariance showed that the mean scores of total self-care behavior and its dimensions increased significantly in the intervention group compared to the control group immediately and three months after the educational intervention (Table 3).

The results of the paired t-test indicated that the mean scores of total self-care behavior and its dimensions increased significantly in the intervention group immediately and three months after the educational intervention compared to the pre-intervention stage. In the control group, the changes for adherence to diet (before and three months after the intervention) significantly increased, the blood sugar self-control (before and immediately after the intervention) significantly increased, and consumption of insulin and diabetes drugs (before and immediately after the intervention and also before and three months after the intervention) significantly reduced (Table 3).

Table 4 shows the results of comparing the mean amounts of glycosylated hemoglobin (HbA1c) in the intervention and control groups before and three months after the intervention. The results of the paired t-test indicated that the mean amount of glycosylated hemoglobin was significantly lower in the intervention group three months after the educational intervention than before the intervention but changes were not significant in the control group before and three months after the educational intervention. Furthermore, the results of the analysis of covariance indicated that glycosylated hemoglobin level significantly improved in the intervention group compared to the control group three months after the educational intervention.

Discussion

The theory of planned behavior affects the individuals' intention to perform behavior as a theory of behavioral change through three constructs, namely attitude, abstract norms, and perceived behavioral control. Creating a positive and desirable attitude towards a behavior is associated with the possibility of intending to perform that desired behavior (22). The present study indicated an increase in mean scores of attitude towards self-care behavior in the intervention group immediately and three months after an education program. Therefore, educational interventions are effective in creating the belief that self-care behaviors lead to positive health outcomes, and it is expected that patients will continue to adopt and maintain self-care behaviors under the influence of this belief. The findings were also supported by the results of previous studies (23).

Abstract norms or social pressures are among the constructs of the Theory of Planned Behavior (TPB) that has is positively related to health behaviors. The individuals' mental perception of others' approval or denial of health behavior is considered as an abstract norm (24). Findings of the present study indicated that mean scores of abstract norms increased significantly in the intervention group immediately and three months after the educational intervention. In other words, the more pressure is exerted by family members on patients to perform health behaviors, the more the patients will adopt that behavior. Inconsistent with the finding, Dashtian et al. found that the educational intervention was ineffective in improving the perceived abstract norms for adherence to medication by diabetic patients due to the lack of participation of patients' families in educational interventions (18), while patients' families were also intervened in the present study.

Consistent with the results of the present study, Nehtani et al. (25) found that an educational intervention on patients with hypertension led to the significant improvement in all constructs of the theory of planned behavior, including abstract norms as well as self-care behaviors. It should be noted that the target groups of the present study and Nehtani et al.'s study were not similar, but the similarity of the conceptual framework of the research, educational components, number of education sessions, and follow-up duration (immediately and three months after the intervention) were the reasons for similar results of the two studies. Consistent with the findings of the study, Najimi et al. (26) reported that holding educational programs for members, who affected the participants, could improve abstract norms to support self-care

behaviors in patients with type 2 diabetes. According to the results, we suggest that health care providers should pay special attention to people affecting diabetics to improve the patients' self-care behavior.

The perceived behavioral control was another construct of the study as an important prerequisite for adopting health behaviors (16). Perceived behavioral control affects a person's willpower by increasing the level of perceived control over the behavior. In other words, if people feel that they have the ability, opportunity, skill, resources, and facilities to perform a particular health behavior, they will have more intention to do that behavior and will seriously pursue it (27). Based on the findings of the present study, the mean score of the construct increased significantly in the intervention group after the educational intervention compared to before the intervention and compared to the control group. Lin et al. (28) and Paleeratana et al. (29) also found similar results to the present study, indicating that education based on the theory of planned behavior was effective in improving perceived behavioral control and self-care behaviors in diabetics. Therefore, the perceived behavioral control should be prioritized as a determinant of self-care behavior in patients with type 2 diabetes to design educational interventions.

The findings of the present study indicated that the educational intervention increased significantly the mean score of intention to perform self-care behaviors in the intervention group compared to the previous intervention and the control group. The finding indicated that the educational intervention in the present study indirectly led to the improvement of the behavioral intention construct and ultimately to the improvement of self-care behaviors by a direct effect on three constructs, attitude, abstract norms, and perceived behavioral control.

Al Lenjawi et al. conducted a study on type 2 diabetic patients in Qatar and their results, in line with the results of the present study, indicated the effect of educational intervention through constructs of theory of planned behavior on improving the intention to perform health-related behaviors (30). The results of Rohani et al.'s studies also indicated the effect of educational intervention based on the constructs of the theory of planned behavior on the intention to perform self-care behaviors in diabetics (31).

Following the educational intervention and positive changes in the constructs of the theory of planned behavior, significant positive changes were seen in self-care behavior and its dimensions (including diet adherence, physical activity, blood sugar self-control, insulin, and medication use, and foot care), and glycosylated hemoglobin levels in patients in the intervention group. Consistent with these findings in studies by Mohammadi Zeidi et al. (32), Babazadeh et al. (17), and Lin et al. (28) implemented an educational intervention based on the theory of planned behavior and found a significant increase in mean scores of self-care behaviors of patients with type 2 diabetes.

Findings of the present study indicated an educational intervention significantly increased diet adherence as a component of self-care in the intervention group compared to the control group. The finding was also consistent with a study by Mohammadi Zeidi et al. (32). Therefore, increasing awareness and improving patients' beliefs about diet adherence could play an important role in promoting nutritional behaviors and controlling diabetes.

Health experts consider physical activity as a basic pillar in controlling diabetes (27). Based on the findings of the present study, the educational intervention had a significant effect on improving patients' physical activity in the intervention group, and it was consistent with results of other studies, for instance, Damayanti et al. found the effect of educational intervention based on the theory of planned behavior on improving the adoption of self-care behaviors such as physical activity, blood sugar control, and drug use after three months of educational intervention (33). Ashvandi et al. achieved similar results to the findings of the present study (34).

Blood sugar self-control is very effective in improving the process of controlling blood sugar and preventing complications of diabetes (34). The results of the present study indicated that following an educational intervention in the intervention group significantly improved blood glucose self-control. Najimi et al. (26) and Meng et al. (35) also found the positive effect of educational interventions in promoting blood sugar self-control behavior in China.

The regular and correct use of insulin and drugs is another important step in controlling diabetes. The results of the present study and other similar studies, including a study by Yayuk et al. in Indonesia indicated the positive effect of educational interventions based on the theory of planned behavior in improving the behavior of proper use of drugs and insulin in diabetics (36).

Foot care and non-smoking are other important aspects of self-care behaviors and play an important role in controlling diabetes. Based on the findings of the present study, the educational intervention was effective in improving these dimensions so that the mean score of foot care after the educational intervention in the intervention group was significantly different from before the intervention and the control group. According to the results of the present study, 8% of the intervention group and 5% of the control group had smoked before the intervention, while the percentage of smoking in the intervention group decreased to 3% three months after the educational intervention. The results of a single study by Monfared et al. (37) and Delikler et al. (38) also confirmed the present study, indicating the effect of an intervention based on the theory of planned behavior in improving foot care behavior and reducing smoking.

The examination of glycosylated hemoglobin levels periodically and for a long time is a method of controlling type 2 Diabetes. It is important to evaluate it during the treatment of patients with type 2 Diabetes to achieve an appropriate and acceptable level of blood sugar, and a high level of HbA1c predicts the progression of its complications. Based on the findings of the present study, a significant improvement was seen in the glycosylated hemoglobin level in the intervention group compared to before the intervention and the control group three months after the educational intervention. Consistent with this finding, Lin et al. (28), Paleerat et al. (29), and Delikler et al. (38) also indicated that education based on the theory of planned behavior was effective in improving self-care behavior and hemoglobin glucose levels in diabetic patients.

In most studies, an educational intervention based on the theory of planned behavior improved self-care behaviors and glycosylated hemoglobin levels in patients with type 2 diabetes during 2-3 months after the

intervention. The reason for the similarity of the studies to the present study included the target population and similar inclusion criteria, use of the same conceptual framework (theory of planned behavior), similar topics, number of similar education sessions (5 sessions), and similar follow-up duration (3 months). Therefore, the theory of planned behavior can be used by considering advantages such as low cost, easy learning, and high effectiveness as care and educational measure to improve self-care behavior, and glycosylated hemoglobin levels.

Given the positive effect of education based on the theory of planned behavior among patients with type 2 diabetes, the attention and focus of health officials on holding education courses with an approach to the theory of planned behavior among patients with type 2 diabetes can have significant results in improving self-care behavior, and glycosylated hemoglobin levels, and ultimately the diabetics' health.

Declarations

Ethics approval and consent to participate

The current study was conducted according to the Declaration of Helsinki and approved by the medical ethical committee of Urmia University of Medical Sciences (IR.UMSU.REC.1399.231) Subsequently written informed consent was obtained for all Patients included in this study.

Competing interests

The authors declare that they have no conflict of interest in this work.

Consent for publication

Not applicable.

Availability of data and materials

All data generated or analysed during this study are included in this published article.

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Authors' contributions

Study design: MP, AD

Data collection and analysis: MP, AD, HKh

Manuscript preparation: MP, AD, MM

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Tables

Table 1
Comparison of demographic and clinical characteristics in the two groups at the pre-intervention

Qualitative variable		**Groups**		***p***
		Intervention	**Control**	
		n (%)	**n (%)**	
Gender	Female	22(73.3)	22(73.3)	1.00[a]
	Male	8(26.7)	8(26.7)	
Marital status	Single	4(13.4)	4(13.4)	1.00[a]
	Married	26(86.6)	26(86.6)	
Educational level	Elementary	7(23.3)	9(30.0)	0.213[a]
	Under- diploma	7(23.3)	11(36.7)	
	Diploma	5(16.7)	6(20.0)	
	University	11(36.7)	4(13.4)	
Employment status	Housewife	16(53.3)	18(60.0)	0.055[a]
	Government employee	10(33.3)	3(10.0)	
	Self-employed	4(13.4)	9(30.0)	
Economic status	Low	6(20.0)	10(33.3)	0.095[a]
	Medium	16(53.3)	18(60.0)	
	Good	8(26.7)	2(6.7)	
Duration of diabetes (year)	Under 2	1(3.3)	3(10.0)	0.341[a]
	2-5	10(33.3)	5(16.7)	
	6-9	8(26.7)	7(23.3)	
	10 and more	11(36.7)	15(50.0)	
Type of Treatment	Oral Agents	22(73.3)	26(86.6)	0.403[a]
	Insulin	5(16.7)	2(6.7)	
	Both	3(10.0)	2(6.7)	
Quantitative variable	Intervention		Control	
	Mean	SD	Mean	SD
Age (year)	52.73	9.88	55.40	11.78	0.346[b]

Qualitative variable			Groups		*p*
			Intervention	Control	
			n (%)	n (%)	
Fasting Blood Sugar (mg/dl)	146.37	40.84	166.43	47.60	0.085[b]
HbA1c (%)	7.56	1.08	8.023	1.70	0.215[b]

Table 2
Mean scores of the TPB constructs at the before, immediately and three months after the intervention in the two groups

constructs of TPB	Group	Research phase							
		Before intervention		Immediately after intervention			Three months after intervention		
		Mean	SD	Mean	SD	p-within†	Mean	SD	p-within‡
knowledge	Intervention	16.40	3.76	19.93	0.63	0.001	19.56	0.89	0.001
	Control	16.50	3.41	16.33	3.45	0.637	16.50	3.76	1.00
	p- between	0.915		0.001			0.001		
Attitude	Intervention	66.20	8.36	70.73	2.92	0.005	67.83	3.53	0.317
	Control	65.06	7.83	60.06	6.20	0.001	59.16	6.01	0.001
	p- between	0.590		0.001			0.001		
Subjective norms	Intervention	63.90	8.86	77.97	3.52	0.001	76.10	4.45	0.001
	Control	59.76	6.97	57.53	5.03	0.003	59.06	7.15	0.430
	p- between	0.049		0.001			0.001		
perceived behavioral control	Intervention	63.26	7.56	76.93	3.65	0.001	76.50	4.81	0.001
	Control	60.43	9.91	57.80	9.48	0.022	59.46	8.82	0.397
	p- between	0.218		0.001			0.001		
Behavioral intention	Intervention	66.13	8.32	78.46	1.77	0.001	77.26	3.37	0.001
	Control	63.07	11.34	61.43	9.27	0.027	62.23	10.04	0.290
	p- between	0.233		0.001			0.001		

* Comparing the mean scores of TPB constructs between the two groups (intervention and control) in the pre-intervention stage based on independent t-test

** Comparing the mean scores of the TPB constructs between the two groups (intervention and control) in the stages immediately and 3 months after the intervention based on the ANCOVA test

† Comparing the mean scores of the TPB constructs in the stages before and immediately after the intervention within each group based on paired t-test

‡ Comparing the mean scores of the TPB constructs in the stages before and three months after the intervention within each group based on paired t-test

Table 3
Mean scores of the self-care behavior and its dimensions at the before, immediately and three months after the intervention in the two groups

Self-care behavior and its dimensions	Group	Research phase							
		Before intervention		Immediately after intervention			Three months after intervention		
		Mean	SD	Mean	SD	p-within†	Mean	SD	p-within‡
Total	Intervention	52.26	14.75	78.73	7.80	0.001	76.66	8.87	0.001
	Control	48.76	16.02	51.36	14.51	0.124	49.86	12.99	0.546
	p- between	0.382		0.001			0.001		
General and specific diets	Intervention	22.20	6.05	27.60	5.17	0.002	29.43	5.48	0.001
	Control	21.00	5.93	23.53	6.04	0.060	23.53	4.81	0.014
	p- between	0.441		0.001			0.001		
Exercise	Intervention	5.17	4.04	8.60	2.51	0.001	7.60	2.60	0.001
	Control	4.20	4.28	4.13	3.69	0.904	4.23	3.35	0.953
	p- between		0.373	0.001			0.001		
Blood sugar testing	Intervention	5.03	4.15	9.53	2.08	0.001	8.73	2.31	0.001
	Control	3.03	2.78	4.23	3.10	0.011	3.73	2.39	096.0
	p- between	0.033		0.001			0.001		
Insulin injection, or taking anti-diabetic pills	Intervention	5.40	2.28	6.63	0.92	0.001	6.38	1.09	0.001
	Control	5.93	1.72	5.20	1.73	0.027	4.60	1.88	0.001
	p- between	0.311		0.001			0.001		
Foot care	Intervention	13.47	8.42	25.36	2.95	0.001	23.53	3.09	0.001
	Control	13.70	7.86	13.40	6.33	0.705	12.80	4.97	0.347
	p- between	0.912		0.001			0.001		

* Comparing the mean scores of self-care behavior and its dimensions between the two groups (intervention and control) in the pre-intervention stage based on independent t-test

** Comparing the mean scores of the self-care behavior and its dimensions between the two groups (intervention and control) in the stages immediately and 3 months after the intervention based on the ANCOVA test

Self-care behavior and its dimensions	Group	Research phase						
		Before intervention		Immediately after intervention			Three months after intervention		
		Mean	SD	Mean	SD	p-within†	Mean	SD	p-within‡
† Comparing the mean scores of the self-care behavior and its dimensions in the stages before and immediately after the intervention within each group based on paired t-test									
‡ Comparing the mean scores of the self-care behavior and its dimensions in the stages before and three months after the intervention within each group based on paired t-test									

Table 4
Mean score of HbA1c at the before and three months after the intervention in the two groups

HbA1c	Group	Research phase				
		Before intervention		Three months after intervention		
		Mean	SD	Mean	SD	p-within‡
	Intervention	7.56	1.08	6.38	0.16	0.001
	Control	8.02	1.70	8.02	0.25	0.134
	p- between	0.215		0.001		
* Comparing the mean scores of self-care behavior and its dimensions between the two groups (intervention and control) in the pre-intervention stage based on independent t-test						
** Comparing the mean scores of the self-care behavior and its dimensions between the two groups (intervention and control) in the stages immediately and 3 months after the intervention based on the ANCOVA test						
‡ Comparing the mean scores of the self-care behavior and its dimensions in the stages before and three months after the intervention within each group based on paired t-test						