Original Article

The impact of self-efficacy education based on the health belief model in Iranian patients with type 2 diabetes: a randomised controlled intervention study

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Background and Objectives: Type 2 diabetes is a chronic illness which can be managed by patients' commitment to self-care and self-efficacy behaviors. **Methods and Study Design:** A randomized controlled intervention study was carried out to determine the impact of self-efficacy education based on the Health Belief Model (HBM) in 240 patients with type 2 diabetes at the Golestan Hospital, Ahvaz, Iran between October 2014 and August 2015. The education duration was three months followed by a 24-week follow-up visit to determine the progress of the subjects. In this study, reliable and validated diabetes educational booklet and questionnaires based on knowledge, health beliefs and quality of life were used. The participants were randomly allocated to either the intervention group (n=120) or to the conventional dietary counseling group as controls (n=120), and assessed at the baseline, week 12 and week 36. The study was divided into primary outcome measurements consisting of glycated hemoglobin A1c (HbA1c), fasting blood glucose, lipid profile, and anthropometric levels. Secondary outcome measures were related to nutrition knowledge, health beliefs and quality of life. **Results:** The results showed that subjects in the intervention group had significantly better metabolic and glycemic profiles compared with those in the control group. It also showed that knowledge, health belief and quality of life significantly increased in the intervention group. **Conclusions:** Findings indicate that through tailored self-efficacy education, the quality of life and metabolic profile of diabetes patients can be improved.

Key Words: health belief model, type 2 diabetes, self-efficacy education, quality of life, metabolic profile

INTRODUCTION

Diabetes is a medical condition that is nearing epidemic proportions globally.[1] Type 2 diabetes is a disease common among people who are overweight, lead a sedentary lifestyle, and are genetically predisposed to it.[2] Bearing in mind, some risk factors for type 2 diabetes are age, gender, ethnicity, family history, socioeconomic status, lifestyle, and obesity.[3,4] However, diet and physical activity can delay the starting point of type 2 diabetes.[5]

Between 2010 and 2030, a 70% increase in prevalence of type 2 diabetes in developing countries and 20% increase in developed countries is expected.[6] The International Diabetes Federation (IDF) predicts the global population of diabetes patients to be 415 million in 2015 and rise to 642 million by 2040. There are nearly 4.6 million diabetes patients in Iran accounting for 8.5% of its population.[2] The incidence occurrence is 7.3%-7.7% among those above 30 years old.[7] The World Health Organization estimates the number of patients with diabetes in Iran to reach over six million in 2030 and 9.2 million in 2040.[8]

Since maintaining an ideal blood glucose level is necessary in the treatment of diabetes,[9] the International Diabetes Federation suggests that patients with diabetes should take greater responsibility through self-care activities ranging from a healthy diet, taking medicine, being active, and regular blood glucose monitoring.[2]

Many patients with type 2 diabetes in Iran, appear not to follow their physician's self-care recommendations. A study to evaluate the lifestyle and nutrition intake of type 2 diabetes patients in the city of Ahvaz showed that patients needed to be educated on avoidance of diabetes related complications by adopting a healthy dietary habit.[10] Assessing the needs for diabetes education among patients with type 2 diabetes in Ahvaz were also applied prior to this intervention study.[11,12] The lack of sufficient educational intervention among diabetes patients in Ahvaz calls for more studies to address the shortcoming.

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METHODS

A matched-pair design randomized controlled study was undertaken to evaluate the impact of self-efficacy education based on Health Belief Model (HBM) in 240 patients with type 2 diabetes. The research was conducted between October 2014 and August 2015 at the Golestan Hospital outpatient diabetes clinic in Ahvaz, southwest of Iran. Respondents (patients) were selected using the probability sampling method, and included those with type 2 diabetes aged between 30 and 65 years, without severe complications and were able to read Persian.

After receiving approval with project code of NN-065-2014 from the Ethics Committee of Universiti Kebangsaan Malaysia (UKM, or National University of Malaysia), data collection was carried out via face-to-face interview with patients. Only patients who met the inclusion criteria and had signed the consent form were recruited to participate in the study. Reliable and valid diabetes educational booklet, knowledge, health belief and diabetes quality of life questionnaires were also used. With regards to educational intervention, the aim was 12-week educational sessions for three months with a 24-week post-intervention follow-up. The outcomes were evaluated at the baseline, week 12 and week 36. The primary outcome measurements were glycemic and metabolic control assessed by glycated hemoglobin A1c (HbA1c), fasting blood glucose, lipid profile, and anthropometric measurements. The secondary outcome measures included improvement in nutrition knowledge, health belief and quality of life.

Three blood samples were collected using a syringe before and after intervention and during follow-up visits; subjects were referred to the clinic laboratory to check their HbA1c, FBS, and lipid profile. The questionnaires were filled out by the control and intervention groups. The educational intervention consisted of 8 sessions (2 hours per session). An educational booklet was given to the intervention group. Subjects were educated about diabetes and its complications, self-care and self-efficacy behavior, physical activity, healthy diet, medication adherence and to self-monitor their blood glucose level. During the three-month intervention, the control group received only conventional dietary counseling. Follow-up was 6 months' post intervention. During this period, patients were allowed to ask questions via phone calls to the researcher.

An educational diabetes booklet, knowledge and health belief questionnaire were designed to measure the degree of knowledge and understanding of patients in managing their diabetes. The knowledge questionnaire was adapted and modified based on validated questionnaires include B5 diabetes knowledge questionnaire, southeast Chicago diabetes community action Coalition and Diabetes Knowledge Questionnaire (DKQ-24) from the Starr County Diabetes Education Study.[13,14] A questionnaire consisting of 39 questions on diabetes covering topics such as definition, types, risk factors, symptoms, complications, main aspects of self-care, and main aspects of dietary management and the importance of physical activity was developed.

The content validity was established by circulating the booklet and questionnaires among 20 lecturers, health professionals, and diabetes specialists. The Cronbach's alpha reliability coefficient for knowledge questionnaire was 0.91, suggesting good reliability.

The total knowledge score was determined as a mean of 39 items; a correct answer=1 and an incorrect answer=0. Therefore, the overall knowledge score was calculated as the total of all correct answers. Each question had only one correct answer. Questions which participant failed to respond (blank values) were considered as incorrect responses. Each correct response was assigned 1 point and incorrect or no response was assigned 0 point. Participants who scored 0 to 9 were classified as having inadequate knowledge; 10 to 24 as marginal; and 25 to 39 as having adequate knowledge.

The subjects were also requested to evaluate the booklet's content, illustration, and design.[15] Problems identified by the subjects were recorded and appropriate changes were made. The total point based on patients 'opinion was 54.1±2.55 in the category of above average.

Health belief related to diabetes disease scale consisted of 42 items divided into five subscales measuring five constructs of the HBM (six items for perceived susceptibility, five items severity subscales, eight items in the perceived benefits subscale, 12 items in the perceived barriers subscale and 11 items for perceived self-efficacy). The questions were adapted from a HBM questionnaire which was developed and validated previously.[16] Perceived susceptibilities are the probability of contracting certain conditions within a specified time frame. An individual's view of the seriousness of a specific condition and its own consequences is referred to as perceived severity.[17] Perceived benefits are the positive effects associated with a specific behavior.[18] Perceived barriers are the negative effects associated with a specific behavior[19] Self-efficacy is having the confidence in one's ability to perform a particular behavior.[17]

All the 42 questions of the health belief questionnaire used the Likert scale format, 5=strongly agree, 4=agree, 3=neither agree nor disagree 2=disagree, and 1=strongly disagree. For perceived barrier construction, the reverse (strongly disagree as 5 and agree as 1) was considered.

In order to determine content validity, a panel consisting of 20 experts was consulted from department of nutrition and dietetics at Ahvaz Jondishapour University of Medical Sciences. To define reliability, the questionnaires were given to 200 individuals not part of the study. The Cronbach's alpha for the entire 42 items in the health belief questionnaire was 0.82 which shows good reliability.

The Diabetes Quality of Life (DQOL) questionnaire was used to evaluate health-related quality of life (HRQoL) for Type 2 diabetes.[20] There are 46 core items (10 additional items for adolescents) and four major dimensions: treatment satisfaction, treatment impact, concerns over long-term complications and concerns over social/vocational issues. A five-point Likert scale used ranging from 1 (very satisfied) to 5 (very dissatisfied) in satisfaction domain, and from 1 (never) to 5 (all the time) in impact and worry domains.

Responses are summed up in the corresponding domains. A 100-point scale is used where zero represents the lowest possible quality of life, and 100 represents the

highest possible quality of life. The score for treatment satisfaction component ranges from 0 to 75 while the score for treatment impact component could range from 0 to 100. The total DQOL scores determined by summing the raw scores of the subscales. Higher scores indicate a more positive quality of life.

The questionnaire consists of three diabetes-specific subscales: satisfaction, impact, and worry.[21] High scores on the satisfaction scale indicate high levels of satisfaction with self-management behaviors and satisfaction with social and physical functioning; high scores on the impact scale indicate low frequency of adverse events related to diabetes and infrequent restrictions or interruptions to social and physical functioning; high scores on the worry scale indicate that the person is unlikely to be concerned about the effect of diabetes on their social and physical functioning. An Iranian version of the DQOL questionnaire has been translated and validated among males and females diagnosed with type 2 diabetes.[22]

Data was analysed using the Statistical Package for Social Sciences (SPSS Inc, Chicago, IL, USA) software version 21. Descriptive data were expressed as mean, standard deviation, frequency, and range. Two-way repeated measure ANOVA, independent t-tests, Chi-square test, paired t-test, Mann-Whitney test and Friedman repeated measure test were performed to compare these two groups. The level of significance was $p < 0.05$ for all tests.

Table 1. Socio-Demographic status of subjects in the intervention and control group at baseline (n=200)

Characteristics	Type 2 diabetes patients (n=200)	
	Intervention (n=100)	Control (n=100)
Age		
30-50 years	45	46
51-65 years	55	54
Marital status		
Married	84	75
Widowed	12	21
Divorced	4	4
Employment status		
Government employee	26	33
Private sector employee	29	25
Retired	1	6
Housewife	42	36
Monthly household income (Rial)[†]		
<5,000,000	5	3
5,000,000-8,000,000	61	44
>8,000,000	20	40
>12,000,000	14	13
Education level		
Primary	34	40
Secondary	51	51
University	15	9

[†]1,000,000 Iranian Rial=40.15 USD.
[‡]No significant differences between two groups by chi-square test ($p>0.05$).

RESULTS

In this study, 400 type 2 diabetes patients at an outpatient clinic, Golestan Hospital, were randomly selected; only 240 subjects met the inclusion criteria. They were divided equally into the intervention and control groups (n=120). The attrition rate in this study showed that at the end of six months, 200 subjects completed the study, indicating a total dropout rate of only 16.6% (Intervention group=8.3%, Control group=8.3%). Socio-demographic characteristics of subjects were recorded and no significant differences were observed between the two groups in this regard (Table 1). The mean age in the intervention group was (51.2±6.21) and in the control group was (51.4±6.03).

Thirty-seven percent of subjects (n=74) had primary education while 12% (n=24) were highly educated. Majority of the subjects (51.5%) had low levels of education.

Results revealed majority of the subjects (77%) were diagnosed with diabetes in the past four years. The mean duration of diabetes was six years. At least 55% of the subjects had a family history of diabetes. Almost 55.5% of the subjects had other medical complications in which 16.5% of them had retinopathy, 24% neuropathy and 15% of the subjects had neuropathy.

There were no significant differences in the glycemic and lipid profile between the two groups at the baseline. However, after intervention via education, there were significant differences in all the variables of the two groups which were significantly reduced in the intervention group compared with the control group ($p<0.001$) (Table 2).

All subjects had fasting blood sugar levels greater than 110 mg/dL at the baseline. A significant reduction was detected in fasting blood glucose after educational intervention ($p<0.001$), where the mean fasting blood sugar was 174±33.8 mg/dL before educational intervention which dropped to 137 ±12.3 mg/dL at the follow-up visit, 6 months after intervention. Same trends were detected among the control group with less mean differences from baseline to the follow-up visit compared with the intervention group (14.5±18.8 vs 37.3±26 mg/dL).

A significant decrease in glycated hemoglobin was reported post-intervention. The mean glycated hemoglobin was 7.97±1.01% before educational intervention led to a significant decrease, 7.29±0.66%, after the follow-up visit among the intervention group (Figure 1). The same results were seen in the changes in FBS level among the two groups (Figure 2).

Total cholesterol, LDL and triglycerides showed a significant decrease in the intervention group ($p<0.05$ level). Total cholesterol (TC, mg/dL) levels also continued to decline for the intervention group. This suggests that educational intervention for diabetes is effective for lowering TC levels. However, for the control group, there was a decrease in TC after intervention but it showed an increase at the follow-up (Figure 3). The same trend was noted for LDL cholesterol and triglycerides levels.

At the baseline, there were no significant differences in anthropometric parameters between intervention and control groups. Nevertheless, significant differences were seen in all anthropometric variables between two groups and within groups after intervention (Table 3).

A total of 9.5% of patients had normal weight (BMI 18.5-24.9 kg/m^2), 83.5% were overweight (BMI 25-29.9 kg/m^2) and 7% were obese (BMI ≥30 kg/m^2 before intervention. Nearly 99% of these patients were abdominally

Table 2. Mean differences in glycemic and lipid profile after 6 months in the intervention (n=100) and control group (n=100)

Variables	Type 2 diabetes patients (n=200)				
	Pre-test	Post-test (12th week)	Follow-up (36th week)	p value[§]	p value[¶]
HbA1c %					
I	7.97±1.01	7.62±0.81	7.29±0.66	0.001**	0.001**
C	8.29±0.76	8.05±0.71	8.08±0.79	0.001*	
p[‡]	0.012*	0.001**	0.001**		
Fasting blood sugar(FBS)(mg/dL)					
I	174±33.8	154±25.2	137±12.3	0.001**	0.028*
C	171±32.1	161±30.7	157±32.1	0.001**	
p[‡]	0.550	0.055	0.001**		
Total cholesterol(mg/dL)					
I	209±25.5	194±22.2	173 ± 22	0.001**	0.001**
C	208±27.7	206±27.4	211±27.5	0.001**	
p[‡]	0.863	0.001**	0.001**		
LDL cholesterol (mg/dL)					
I	134±20.9	119±16.9	100±16.4	0.001**	0.001**
C	131±22.3	129±21.6	130±21	0.001**	
p[‡]	0.301	0.001**	0.001**		
HDL cholesterol(mg/dL)					
I	46.5±5.85	50.8±5.44	50.3±6.31	0.001**	0.01*
C	47.1±4.86	50.7±4.86	54.6±5.41	0.001**	
p[‡]	0.504	0.924	0.001**		
Triglyceride (mg/dL)					
I	177±28.7	157±24.1	143±21.8	0.001**	0.001**
C	176±23.3	179±22	174±22.5	0.001**	
p[‡]	0.792	0.001**	0.001**		

[†]Data are means (SD), Intervention group=I, Control group=C; n1=n2=100.
[‡]Independent sample t-test.
[§]Two-way repeated measure ANOVA within groups with the baseline values as covariate--(Post hoc was Bonferroni correction).
[¶]Two-way repeated measure ANOVA between groups.
*Significant differences (p<0.05).
**Significant differences (p<0.01).

obese based on a waist circumference ≥90 cm. Based on BMI classification, there was a noticeable improvement in the intervention group compared with control group whereby they were more successful at managing their weight to desired levels. In regard to BMI, results showed a significant decrease in BMI (p<0.001), indicating that the body weight and BMI reduced significantly. Following that, a significant decrease was observed in waist circumference after the educational intervention in the intervention group.

There were no significant differences in the knowledge scores of the two groups before the intervention, but after the intervention, the knowledge scores of the intervention group were significantly higher than the control group (p<0.001) (Table 4).

Results showed a significant increase in the mean score of knowledge among subjects who were educated on diabetes (p<0.05). The mean score of knowledge test before educational intervention in the intervention group was 15.5±10.1 which had increased to 29.8±2.8 after edu-

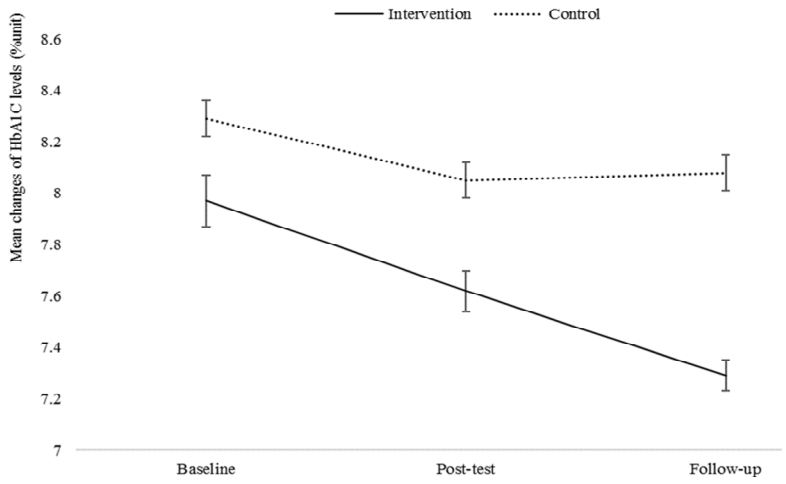

Figure 1. Mean (±SE) differences in HbA1c levels from baseline (%) to follow-up visit in the intervention and control groups.

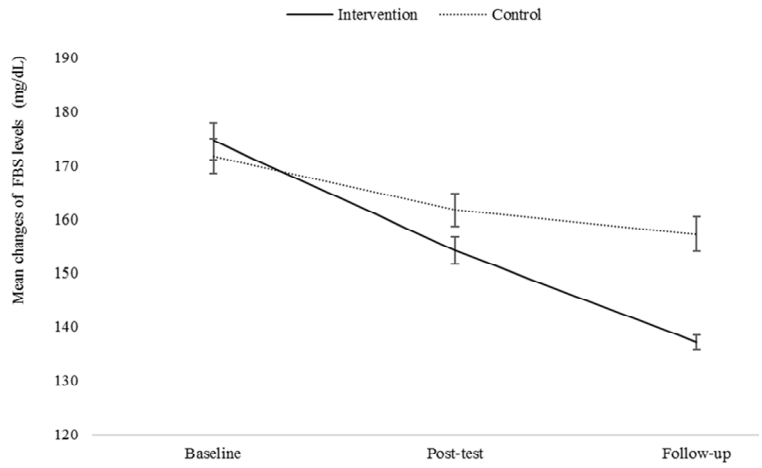

Figure 2. Mean (±SE) changes in FBS level from baseline (mg/dL) to follow-up visit in the intervention and control groups.

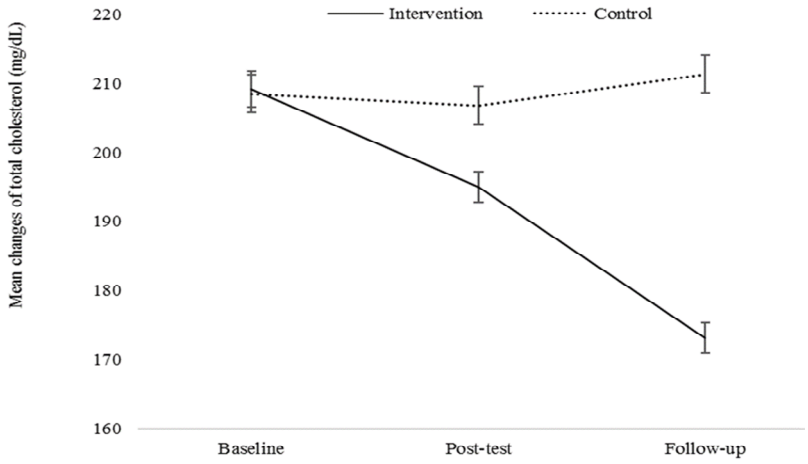

Figure 3. Mean (±SE) changes in total cholesterol levels from baseline (mg/dL) to follow-up visit in the intervention and control groups.

Table 3. Anthropometric measurements of subjects pre and post intervention

Characteristics	Type 2 diabetes patients (n=200)			
	Baseline Mean±SD	Post-test Mean±SD	Follow-up Mean±SD	*p*-value[§]
Weight (kg)				
I	72.2±7.84	70.9±7.84	68.3±6.81	0.001**
C	71.9±7.84	72.8±7.57	72.6±7.48	0.001**
p[‡]	0.822	0.071	0.001**	
BMI (kg/m^2)				
I	27.1±1.92	26.6±1.96	25.7±1.77	0.001**
C	26.9±1.90	27.3±1.92	27.2±1.78	0.001**
p[‡]	0.538	0.014**	0.001**	
Waist (cm)				
I	101±6.10	100±5.92	98.7±5.71	0.001**
C	102±6.13	101±6.14	101±6.33	0.001**
p[‡]	0.805	0.177	0.006**	

[†]I=intervention group; C=control group.
[‡]Independent sample t-test.
[§]Two-way repeated measure ANOVA.
**Significant differences (p<0.01).

cational intervention and reached 30.9±2.1 at the follow-up visit.

Prior to intervention, average levels of perceived susceptibility, severity, self-efficacy, benefits, and barriers were moderate. There were no significant differences between the two groups in the health belief model. Following intervention, values changed significantly in the intervention group compared with the control group (p<0.001). Table 5 shows the mean of the components of the health belief model in the two groups before and after

Table 4. Changes in the diabetes knowledge score of subjects pre and post educational intervention

Knowledge score	Type 2 diabetes patients (n=200)			
	Pre-test Mean±SD	Post-test Mean±SD	Follow-up Mean±SD	*p*-value‡
I (n= 100)	15.5±10.1	29.8±2.81	30.9±2.16	0.001**
C (n= 100)	14 ±9.04	22.3±5.91	22.3±5.91	0.001**
p†	0.271	0.001**	0.001**	

†Mann-Whitney test.
‡Friedman repeated measure test.
§I=intervention group; C=control group.
**Significant differences ($p<0.01$).

Table 5. Changes in the health belief of subjects pre and post intervention

HBM Components	Type 2 diabetes patients (n=200)			
	Pre-test Mean±SD	Post-test Mean±SD	Follow-up Mean±SD	*p* value‡‡
Perceived susceptibility †				
I (n= 100	22.4±1.57	24.1±1.60	24.9±1.74	0.001**
C (n= 100)	22.4±1.59	23.0±1.43	23.3±1.36	0.001**
p††	0.975	0.001**	0.001**	
Perceived Severity ‡				
I (n= 100)	18.2±1.55	19.9±1.26	20.3±1.48	0.001**
C (n= 100)	18.2±1.63	18.8± 1.49	18.9±1.50	0.001**
p††	0.790	0.076	0.006**	
Perceived self-efficacy				
I (n= 100)	37.5±3.45	42.9±2.28	44.5±2.47	0.001**
C (n= 100)	38.3±3.97	39.1±3.57	40.7±3.22	0.001**
p††	0.145	0.873	0.050*	
Perceived benefits §				
I (n= 100)	28.4±3.15	32±2.00	33.1±2.10	0.001**
C (n= 100)	28.6±3.27	29.3±2.81	29.8±2.46	0.001**
p††	0.660	0.001**	0.001**	
Perceived barrier ¶				
I (n= 100)	30.1±3.42	30.7±3.57	29.8±4.00	0.001**
C (n= 100)	29.6±3.17	29.7±3.10	29±3.07	0.001**
p††	0.305	0.038*	0.870	
Total HBM				
I (n= 100)	136±8.00	149±5.40	152±6.36	0.001**
C (n= 100)	137±7.49	140±6.29	141±5.74	0.001**
p††	0.695	0.001**	0.001**	

†The higher the score, the greater the tendency to feel susceptible to diabetes type 2.
‡The higher the score, the greater the tendency to perceive diabetes as serious.
§The higher the score, the greater the tendency to perceive benefits as important for diabetes.
¶The higher the score, the more are barriers for engaging into healthy behaviors.
†† Independent sample t-test.
‡‡ Two-way repeated measure ANOVA.
*Significant differences ($p<0.05$).
**Significant differences ($p<0.01$).

intervention. Perceived susceptibility increased significantly in the intervention group compared with the control group ($p<0.001$). The result was the same for perceived severity, perceived self-efficacy and perceived benefits ($p<0.001$). In contrast, perceived barriers decreased in the intervention group in comparison with the control group ($p<0.001$).

In the benefit subscale, approximately 71% (n=143) of subjects strongly agreed that exercise and healthy eating will decrease their chances of contacting diabetes related complications. The mean score of perceived susceptibility constructs among the intervention group improved significantly after intervention. The mean score of perceived barriers among intervention group noted a statistically significant decline when compared with the control group. Defiantly the mean score of self-efficacy increased over time in the intervention group (Table 5). A similar trend for all constructs was observed among control group with slight changes.

Based on DQOL questionnaire, subjects indicated that they were moderately satisfied with their management and current treatment of diabetes. There were no major differences in the quality of life between the two groups at the baseline, but it increased significantly in the intervention group compared with the control group after intervention (Table 6).

DISCUSSION

This study was aimed at determining the impact of educational programs to improve quality of life, metabolic and

Table 6. Changes in the quality of life of subjects measured by DQOL pre and post intervention

Some of DQOL	Type 2 diabetes patients (n=200)			
	Pre-test Mean±SD	Post-test Mean±SD	Follow-up Mean±SD	*p* value[§]
Impact of treatment (0-100)				
I	71.1±3.17	72.6±2.83	72.9±2.91	0.001**
C	71±2.89	71.9±2.85	71.9±2.87	0.001**
p[‡]	0.510	0.069	0.022*	
Worry in Total(0-100)				
I	38.4±7.64	36.5±7.65	38.7±8.79	0.001**
C	37±7.68	37.2±8.00	37.3±8.16	0.113
p[‡]	0.261	0. 482	0.339	
Diabetes- related worry				
I	30.6±7.49	29±7.45	31.1±8.63	0.001**
C	29.1±7.64	29.4±8.05	29.4±8.05	0.670
p[‡]	0.197	0.669	0.228	
Social/ vocational worry				
I	7.78±1.85	7.46±1.83	7.60±2.00	0.012*
C	7.82±1.80	7.78±1.99	7.92±2.18	0.236
p[‡]	0.907	0.264	0.331	
Satisfaction(0-75)				
I	48.8± 6.46	60.2±7.46	61.3±7.56	0.001**
C	49.4±6.69	49.4± 6.86	50.2±6.83	0.015**
p[‡]	0.715	0.001**	0.001**	
Total DQOL (9-175)				
I	52.8±3.42	56.4±3.55	57.6± 3.99	0.001**
C	52.4±3.10	52.8±3.45	53.2±3.52	0.003**
p[‡]	0.544	0.001**	0.001**	

[†]I=intervention group; C=control group, $n_1=n_2=100$.
[‡]Mann-Whitney test.
[§]Friedman repeated measure test.
*Significant differences ($p<0.05$).
**Significant differences ($p<0.01$).

glycemic profile among patients with type 2 diabetes in southwest of Iran. In this study an educational booklet based on the health belief model (HBM) was designed as a means to increase patients' knowledge and health belief. Findings showed that educational intervention improved their self-control.[23]

The socio-economic results were similar to previous epidemiological studies which showed that chronic diseases, such as type 2 diabetes, are major global public health concern and the prevalence of the disease is strongly influenced by environmental factors such as unhealthy habits and poverty as well as poor socio-economic status.[24-26]

Results of the present study are consistent with previous studies on educational intervention among type 2 diabetes patients in Iran.[27] After six months, subjects indicated lower consumption of red meats, and more vegetables and fruits. As mentioned earlier, a diet with low carbohydrates, high fiber, more vegetables and fruits is recommended for the management of type 2 diabetes.[28,29]

In this study, the knowledge of the intervention group significantly increased after education. The first step in controlling diabetes is education that can be effective in improving patients' self-care and self-efficacy. One of the reasons why patients face difficulty in controlling their blood glucose level is due to lack of awareness.[30] Several studies concluded that lack of knowledge; self-care skills; and correct information about the treatment programs hinder improvements.[11,31]

One important issue is non-compliance and adherence to the treatment plan.[32] Statistical analysis showed a significant difference between HbA1c level before and after intervention in the intervention group comparison with the control group. These results are consistent with earlier studies.[33,34] Some researchers have reported that education has positive effects on reducing levels of hemoglobin A1c and maintaining low levels of it will prevent complications related to diabetes.[34,35]

The reduction in total cholesterol and triglycerides can be attributed to educational awareness whereby subjects are urged to adopt and maintain good dietary habits (read healthy eating) and increase their physical activity levels in the form of exercise. In addition, weight loss has a significant role in reducing the level of triglycerides in the blood. Several studies have also reported a significant difference in triglyceride levels post education in the intervention group.[36,37] The results of this study are compatible with another study conducted among a sample of type 2 diabetes patients in Iran in which a small change was noted in the subjects' waist circumference after they were educated on nutrition and healthy eating.[36]

Overweight is a risk factor for type 2 diabetes and glucose intolerance.[38] Increased physical activities with an appropriate diet have been shown to reduce weight and delay type 2 diabetes complications.[39] In this study, the intervention group had shown weight loss after the intervention. Observations after 6 months showed that both groups had lost weight but their weight loss was more significant among subjects in the intervention group compared with the controls (-3.83±3.05 vs -0.07 1.37 kg).

There was greater weight loss (-2.98 kg) in the intervention group compared with (-1.85 kg) the control group at 6 and 9 months' follow-up from the beginning of the diabetes education program.[40]

Subjects educated on the correct nutrition were able to reduce their BMI level. The results of this study are similar to the findings of earlier studies on the impact of diabetes education on weight loss which affect positively on body mass index.[41] It is noteworthy that a randomized trial in the USA also reported that weight loss to be greater in the intervention group than the control group (8.6% vs 0.7% at 1 year; 6.0% vs 3.5% at study end).[42]

Weight loss improves blood glucose levels by lowering the liver's glucose production and increasing insulin sensitivity. It was also found that increase in physical activity, improves BMI and glycemic control after the six-month intervention.[43] This is due to the role of education in convincing patients on the need to preserve a normal weight so that there is a direct link between weight loss and improved blood sugar level.[26] The results of this study reveal the importance of adhering to and adopting a good dietary habit to an extent that the subjects benefitted from the educational program in particular on weight reduction and BMI. Similar results were revealed in a randomized controlled trial in Japan.[44]

In a randomized, controlled study based on diabetes self-management education among type 2 diabetes patients in Hong Kong, a significant reduction in body weight and hemoglobin A1C was reported in the intervention group compared with the control group. The researchers believed that diabetes self-care education can improve HbA1c levels and body weight among those diagnosed with type 2 diabetes.[33]

Following intervention, the knowledge level of intervention group showed a higher score than the control group. The results of the present study showed that nutritional education could increase subjects' knowledge and reduce their fasting blood glucose level. Before the intervention, the mean of diabetes knowledge scores was moderate for both groups. Similarly, medium level of diabetes knowledge among subjects was reported before intervention in the study among type 2 diabetes patients in Iran.[45] Nutritional knowledge of diabetes in several studies, significantly increased after educating the intervention group compared with the control group.[45,46] Health literacy is important among patients with chronic diseases to manage their diseases.[47] Furthermore, patients with different educational qualifications may respond in a different way to a lifestyle intervention for weight and diabetes control.[48]

Our results showed significant improvements in average response for perceived susceptibility, severity, benefit, and self-management among the intervention group. Additionally, after the intervention, the average response in relation to the barrier to self-management decreased among the intervention group. This finding is in agreement with the results of an earlier study that focused on diabetes patients in Iran to determine the effectiveness of self-management educational program based on health belief model.[49]

Other educational intervention studies based on HBM model among type 2 diabetes patients in Iran also indicated that the mean scores of HBM structures in groups, before and after the educational intervention, have a statistically significant difference. There was significant improvement in mean scores of perceived susceptibility and severity and self-efficacy in the intervention group after education.[34,50]

In total, 46% of subjects in this study had diabetes-related complications with a significantly decreased quality of life.[51] In addition, it was stated that patients who were obese, those who had complications of type 2 diabetes and were using insulin, had lower HRQoL independent of their age and sex.[52] Similar results were obtained in the present study. Health-related quality of life in this study was influenced by this fact and when BMI, TC, LDL-C and triglyceride levels changed after the intervention, there was a corresponding improvement in quality of life. A study conducted in Turkey reported that diabetes patients who were obese and had diabetes complications had lower HRQoL.[53] Similarly, in another study, major diabetes complications were associated with worse quality of life.[54]

Following intervention, significant differences were noted between the two groups. Quality of life among intervention group was considerably much better than the control group while in the worries construct, there were no differences because of the type of questions posed which did not depend on the intervention.

In a meta-analysis, it was revealed that people with diabetes had improved QOL after being involved in diabetes self-management programs.[55] Similar results were obtained in a semi-experimental study among 60 patients with type 2 diabetes in Iran who were divided into two case and control groups. After determining the educational needs of the patients, an educational program was conducted for the case group. Findings showed the educational program was effective in improving the general health and quality of life of diabetics.[56]

In a randomized clinical trial among type 2 diabetes patients in the Basque Country, self-care education program was also successful for improving in the quality of life among the intervention group.[57] A study among type 2 diabetes patients in Iran revealed that education can have a positive effect on diabetes self-concept and prevent physical and side effects of type 2 diabetes.[58]

The study shows that lifestyle modification through patient education is the mainstay treatment strategy for type 2 diabetes.[59] The diabetes self-management education strategies as recommended by the National Standards for Diabetes Care are important because they empower patients and families with knowledge, treatment skills, and social role fulfillment.[60] Based on the results, educational intervention among the intervention group was more successful than the control group with higher mean differences between the baseline and post-intervention in the follow-up visit. Furthermore, significant differences were observed between intervention and control group in post-intervention follow-up visit.

The findings of this study indicate that tailored diabetes education can promote self-care activity and self-efficacy among diabetes patients and improve their quality of life. Since education is a major component of health care, education and interactive behavior changes are important

for effective changes. Effective educational intervention based on behavior patterns reduces complications, morbidity, and mortality among those suffering from diabetes.

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AUTHOR DISCLOSURES

The authors declare no conflict of interest.

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