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The Effect of Educational Interventions on Glycemic Control in Patients with Type 2 Diabetes Mellitus

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ABSTRACT

Background: Diabetes mellitus is a chronic disease with many serious complications.
Objectives: The present study aimed to assess the effect of educational interventions on glycemic control represented by changes in glycated hemoglobin (HbA1c) levels in the patients with type 2 diabetes.
Patients and Methods: This study was performed on 100 adults with type 2 diabetes using computerized randomization based on registration numbers from June to November 2012. An educational course of diabetes together with exercise training and nutritional education was designed for the study population in order to increase the patients' knowledge and attitude toward diabetes and to increase their participation in self-monitoring of blood glucose.
Results: All the 100 diabetic patients completed the educational course. The mean age of the participants was 57.76 ± 10.03 years (range: 40 - 75 years). HbA1c changes three months after completion of the educational interventions were compared to baseline values using paired sample t-test. According to the results, the mean level of HbA1C was significantly lower at the 3-month follow-up compared to the baseline (8.09 ± 0.31 versus 8.51 ± 0.26, P < 0.001).
Conclusions: The educational interventions effectively improved the diabetic patients' glycemic control and are, thus, highly recommended for diabetic patients.

►*Implication for health policy/practice/research/medical education:*
The aim of this study was to assess the effect of educational interventions on glycemic control of patients with type 2 diabetes as represented by changes in glycated hemoglobin (HbA1c) levels. This study was performed on 100 adults with type 2 diabetes. An educational course of diabetes was designed for the study population in order to increase patients' knowledge and attitude toward diabetes, and to increase participation in self-monitoring of blood glucose, together with exercise training and nutritional education.

1. Background

Diabetes is a devastating disease requiring lifelong care and rehabilitation (1). The incidence of diabetes is increasing markedly and according to World Health Organization (WHO), 5.4% of the world population (300 million people) will be diabetic by 2025 (2). Diabetes Mellitus (DM) is an established risk factor for development of Coronary Artery Disease (CAD) and approximately 20 - 30% of the patients undergoing Coronary Artery Bypass Graft (CABG) have DM (3). Overall, more than 171 million individuals suffer from diabetes in the world and this number is expected to reach up to 366 million by 2030 (1). In Iran, the prevalence rate of this disease has been reported to be 7.7% (approximately 2 million adults) within the age range of 25 to 64 years (4). This rather high prevalence rate seems to be increasing Rathmann W, Giani G. Global prevalence of diabetes estimates for the year 2000 and projections for 2030 (5). Diabetes is associated with significant healthcare costs. The aggregate annual direct costs of diabetes in Iran are estimated to be 591 ± 66 million US dollars (6).

Stabilization of blood glucose is the primary goal of diabetes management. This depends upon carrying out

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a number of different self-care behaviors and a complex management regimen involving exercise, dietary modification, foot-care, Self- Monitoring of Blood Glucose (SMBG), and administration of medications (7). Meanwhile, use of Hemoglobin A1c (HbA1c) as a diagnostic test for diabetes has been suggested by an international expert committee and has been supported by WHO consultation (8). High HbA1c levels are associated with an increased risk of diabetes complications. In the United Kingdom Prospective Diabetes Study (UKPDS), a 1% reduction in HbA1c was associated with 14% reduction in myocardial infarction, 37% reduction in micro vascular complications, and 43% reduction in amputation (9, 10). Therefore, it seems that ultimate control of blood glucose level is in the hands of HbA1c.

Recent studies have shown that few patients follow multiple self-care behaviors at the recommended levels (11). A study in Asian countries from 2001 to 2002 found that more than half of the adult diabetics had HbA1c levels greater than 7.5% (12). In Malaysia, 73% of diabetics had HbA1c levels above 7.5% (13).

Diabetes education is considered to be essential in reaching a good glycemic control (14). This aims at increasing the knowledge of self-management principles and skills in order to achieve sufficient glycemic control, while psychological behaviors, such as coping with diabetes, have received less attention (15). Yet, lack of knowledge is not usually the only issue (16) and a variety of problems contribute to self-management difficulties (17). Health-related quality of life should also be a matter of concern in diabetes education (15, 18).

2. Objectives

The present study aims to evaluate the effectiveness of educational interventions in glycemic control represented by a decrease in glycated hemoglobin (HbA1c) levels among diabetic patients.

3. Patients and Methods

3.1. Study Design

This 6-month quasi-experimental trial with pre- and post-test design was performed from June to the end of November 2012 at a primary care center in Shiraz, Iran. The study protocol was approved by the Ethics Committee of Shiraz University of Medical Sciences (No. CT-P-91-4406) and written informed consents were obtained from all the participants after providing them with an explanation about the study design and objectives.

3.2. Participants

This study was conducted on 100 male and female adults between 40 and 75 years old who had type 2 diabetes for at least 2 years and had received a maximum of 2 oral diabetes medications. The subjects were selected from Shiraz Healthy Heart House (a primary care center in Shiraz) using computerized randomization based on the registration numbers from June to November 2012. An educational course of diabetes together with exercise training and nutritional education was designed for the study population in order to increase the patients' knowledge and attitude toward diabetes and to increase their participation in SMBG.

3.3. Data Extraction

The exclusion criteria of the study were having received Insulin for glycemic control, presence of major diabetes complications (i.e., proliferative retinopathy, cardiovascular disease, renal disease, severe autonomic neuropathy, and lower limb amputation), and using any medications that might interfere with glycemic control, such as corticosteroids. At the beginning, we collected the data regarding the patients' gender, age, diabetes duration, level of education, amount of daily/weekly exercise, level of knowledge about diabetes and it's complications, and history of other risk factors of cardiovascular diseases using a data gathering form.

Also, blood samples (10 cc) were taken from the patients to measure HbA1c level. An educational course of diabetes was designed for the study population (dtc.uscf.edu). Every week, 20 patients were randomly selected from Shiraz Healthy Heart House and were provided with a multidisciplinary educational program using face-to-face educational techniques in three consecutive sessions each lasting for 60 minutes. The first session was held with a cardiologist delivering general information about diabetes and its complications, risk factors, diagnosis, and importance of self-participation in glycemic control. The second session was held with an expert in sport medicine and all the patients were interviewed and received proper physical activity trainings. Finally, the third session was held with a nutritionist and the patients received nutritional points regarding their Body Mass Index (BMI) and glycemic status. In this way, a total of 100 patients were recruited into the study in five consecutive weeks. The participants were followed for three months after the last session of diabetes education. After all, HbA1c level was re-checked and compared to baseline.

3.4. Statistical Analysis

The data were compared using Paired sample t-test for the continuous variables and chi-square test (or Fisher's exact test if required) for the categorical ones. Besides, Pearson's correlation coefficient was used to assess the correlation between the quantitative variables. This study was done with the power of 80% and P values < 0.05 were considered as statistically significant. All the statistical analyses were performed using the SPSS statistical software, version 16.0 (SPSS Inc., Chicago, IL, USA). The values have been expressed as mean ± Standard Deviation (SD) for the quantitative variables and as percentages for the categorical ones.

4. Results

A total of 100 males and females with type 2 diabetes were included during the study period and all of them completed the three sessions of diabetes education. The mean age of the participants was 57.76 ± 10.03 years. Besides, the mean age of the male and female patients was 60.59 ± 8.65 and 54.14 ± 10.61 years, respectively. The baseline characteristic of the study subjects have been summarized in Table 1.

Table 1. Baseline Characteristics of the Participants

Characteristic	Men (n = 56)	Women (n = 44)
Mean age	60.59 ± 8.65	54.16 ± 10.61
Education level		
Illiterate	11 (19.6)	6 (13.6)
≤ 6 years	12 (21.4)	13 (29.5)
> 12 years	20 (35.7)	16 (36.4)
> 7 – 12 ≤ years	13 (23.2)	9 (20.5)
Physical activity [a]		
Insufficient	46 (82.1)	41 (93.2)
Sufficient	10 (17.9)	3 (6.8)
Duration of disease		
< 3 years	4 (7.1)	13 (29.5)
3 - 6 years	24 (42.9)	23 (52.3)
> 6 years	28 (50)	8 (18.2)
History of HTN	16 (28.6)	25 (56.8)
History of hypercholesterolemia	24 (42.9)	28 (63.6)
History of smoking	23 (41.1)	4 (9.1)

[a] Sufficient physical activity was defined as 30 minutes of exercise at least 3 days a week.

According to the results, the mean level of HbA1c was significantly lower at the 3-month follow-up compared to the baseline (8.09 ± 0.31 versus 8.51 ± 0.26, P < 0.001). Comparison of the mean HbA1c levels at baseline and at the 3-month follow-up has been shown in Figure 1. In the male participants, the mean level of HbA1c was 8.59 ± 0.26 at baseline and 8.21 ± 0.29 at the 3-month follow-up (P < 0.001). These values were respectively obtained as 8.39 ± 0.03 and 7.94 ± 0.04 in the female participants (P < 0.001). Comparison of the mean levels of HbA1c between the male and female patients at the baseline and at the 3-month follow-up has been presented in Figure 2.

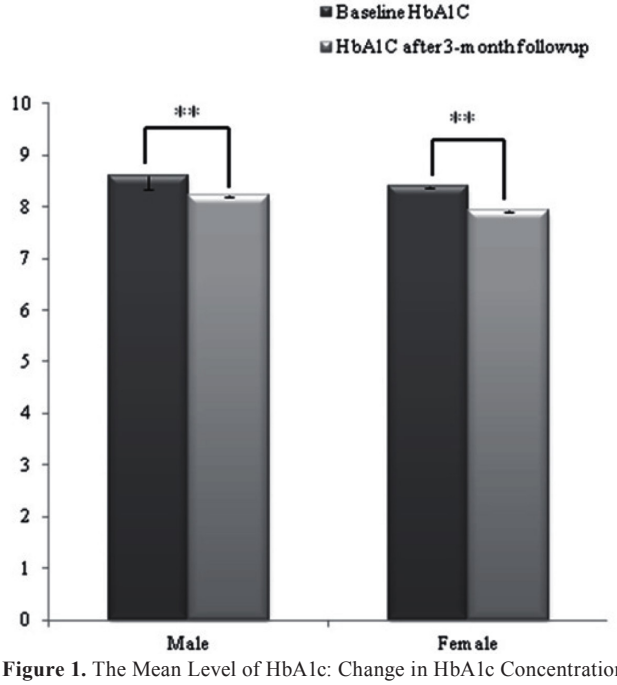

Figure 1. The Mean Level of HbA1c: Change in HbA1c Concentration from Baseline to the 3-Month Follow-up. The Values Marked with Stars Are Statistically Significant (P < 0.001).

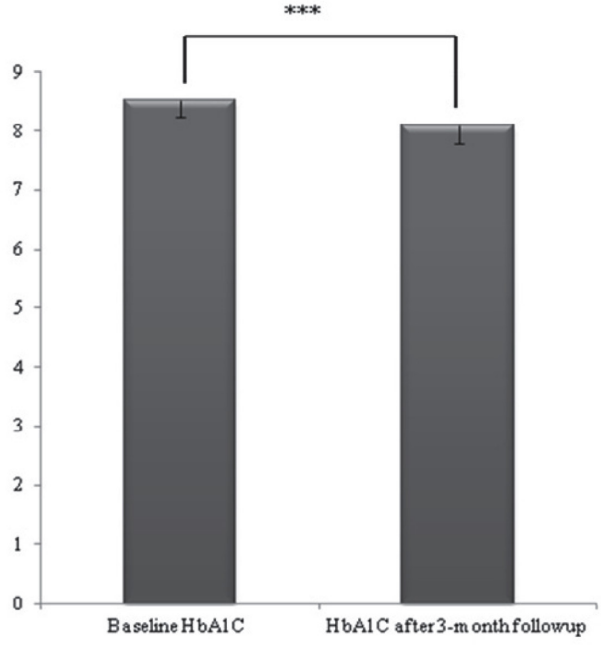

Figure 2. The Mean Levels of HbA1c in Male and Female Patients at Baseline and at the 3-Month Follow-up. The Values Marked with Stars Are Statistically Significant (P < 0.001).

5. Discussion

The present study aimed to assess the effectiveness of educational interventions in controlling HbA1c level among the adults with type 2 diabetes. The study results indicated a significant decrease in HbA1c levels in both male and female participants by the end of the educational course although the duration of follow-up was relatively short (three months). Cochrane collaboration meta-analysis published in 2005 evaluated 11-well designed studies on group-based, patient-centered educational programs for adults with type 2 diabetes. The study results indicated that these programs resulted in significant health outcomes (19). Moreover, Vermeire et al. published a Cochrane review of 21 Randomized Controlled Trials (RCTs) that assessed the effects of interventions on improving adherence to treatment recommendations in the individuals with type 2 diabetes (20). Three out of the four studies on face-o-face education showed reductions in HbA1c levels. In addition, two studies indicated that group education remarkably improved HbA1c (21). In some studies assessing glycated hemoglobin after four to six months, the patients who

attended group educational programs showed a 1.4% decrease in glycated hemoglobin levels (95% confidence interval (CI), 0.8 - 1.9%; P < 0.001) (19). However, the findings of the study by Deakin et al. revealed a smaller effect at four months compared to that reported in other studies at six months (19). Considering the fact that HbA1c is a measure of diabetes control over a period of approximately three months, the researchers concluded that a four-month assessment period might not be long enough for improvement in diabetes control to be apparent. A German study by Kulzer et al. evaluated the efficacy of educational programs for the patients with type 2 diabetes at 3 (t1) and 15 months (t2) after baseline (t0). The results showed a decrease in HbA1c level at 3 months which was also sustained at 15 months (8.1 ± 1.8 at t0, 7.3 ± 1.7 at t1, and 7.4 ± 1.9 at t2) (22). In accordance with other studies, the re s u l t s of our study demonstrated that even a three-month follow-up might be enough to observe a favorable impact on HbA1c level.

Some investigators have proposed that the theoretical models used in establishing relationships between psychosocial/educational interventions and outcomes should be re-evaluated (23). At the time of evaluation of intervention impacts, there would be a debate on the appropriate outcomes to assess (15).

Although in many different studies, metabolic control (assessing fasting blood sugar and HbA1C values) has been considered as the primary outcome, educational and psychosocial interventions are concerned with changing self-management behaviors, attitudes, and beliefs. Therefore, assessment of changes in behavioral and psychological outcomes could serve as more logical targets rather than solitary assessment of changes in metabolic control (24).

Furthermore, diabetes education is likely to be a cost-effective intervention and may reduce healthcare costs. One study reported the cost-effectiveness of two diabetes interventional strategies compared to usual hospital outpatient care in the patients with type 2 diabetes (25).

It is also important to consider the obstacles to conduction of appropriate controlled clinical trials on educational and psychosocial interventions for diabetes (26). Considering the fact that diabetes is a life- threatening disease, it is essential for all the diagnosed individuals to receive basic educational training at the time of diagnosis. However, since our study did not include a control group, the results could not be compared to the situation in which no educational interventions are performed.

Furthermore, it should be considered that alterations in HbA1c levels (metabolic control) could result from various reasons which are apparently out of the interventionists' control (27). As routinely practiced, administration of educational interventions is considered as a supplement to standard medical care. In other words, in a drug trial for example, participants could be forced to take only one medication and other medications are banned during the course of the trial. On the contrary, in a study on educational or psychosocial interventions for diabetes, placing such limitations on diabetic individuals is not ethical. Therefore, medical treatment of individuals may undergo modifications throughout the course of a study, which can affect metabolic control and may further obscure intervention effects. For the best practice, integration of medical care and education is recommended (28, 29). However, isolating the effects of non-medical care would not be possible under these circumstances.

5.1. Future Research

There are a number of limiting factors which could diminish the impact of our study. One limitation was absence of a control group for comparison. However, as it was discussed earlier, evaluating diabetic patients in a group receiving no educational interventions is unethical. Another limitation was that the study only evaluated the effect of the intervention on HbA1c as a measure of glycemic control. Thus, further studies are recommended to assess clinical parameters (e.g. blood pressure and BMI) along with Para clinical parameters in order for better understanding of the effects of educational interventions on general health of adult diabetic patients. Moreover, behavioral or educational theories must have a more explicit role in future studies to improve the understanding of behavior change in self-management of diabetes. The role of self-management training, non-traditional health-care providers, and optimal training of health educators has yet to be determined. The role of individual needs assessment within the context of group teaching must also be brought to the forefront of future researches.

5.2. Conclusion

In conclusion, the results of the present study showed that educational interventions effectively improved glycemic control and are, thus, highly recommended for diabetic patients.

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Authors' Contribution

Mohammad Javad Zibaeenezhad, Kamran Aghasadeghi, Mahmood Zamirian, Ali Reza Moaref, Firoozeh Abtahi: Providing the final draft, supervision; Fatemeh Zade Bagheri and Elham Khalesi: preparing the data, data analysis and first draft.

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