ORIGINAL ARTICLE

Effects of the Problem Solving Technique in Type 2 Diabetic Patients with Cognitive Impairment: A Randomized Clinical Trial

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Abstract

Background: Diabetes mellitus is a common metabolic disorder, one of the lesser known of whose consequences is cognitive disorder. This study aimed to evaluate the effects of problem-solving technique in type 2 diabetic patients with cognitive impairment.

Methods: This randomized clinical trial was conducted in the south of Iran between December 2014 and April 2015. 96 type 2 diabetic patients with cognitive impairment were randomly divided into two groups. The patients in the intervention group attended classes on problem-solving skills, while the patients in the control group attended the usual classes in the clinic. The quality of life, self-management profile, metabolic indexes of the patients in both groups were measured before and three months after the experiment. Data were analyzed using SPSS version 16.0. Paired t-test, independent t-test, Wilcoxon, Mann-Whitney and Chi-Square tests were used.

Results: The differences between the groups' levels of HbA1c (P=0.02) and HDL (P=0.02) were significant, but the differences between their FBS, cholesterol, triglycerides and LDL were not significant (P>0.05). The mean difference of the changes in the quality of life (P<0.001) between the intervention and control groups was significant. The differences between the two groups in the area of self-management were as follows: patient's anxiety management (P<0.001), patient's capability in using medicine (P<0.001), healthy eating (P<0.001), weight management (P=0.02), and confidence in one's ability to manage his/her diabetes (P<0.001).

Conclusion: Applying problem-solving technique significantly enhanced self-management, quality of life and metabolic indexes in type 2 diabetic patients with cognitive impairment.

Trial Registration Number: IRCT2014041517283N1

Keywords: Cognitive dysfunction, Diabetes mellitus, Problem solving, Quality of life, Self-management

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Introduction

Diabetes mellitus is a complicated metabolic disease that can have harmful effects on various organs in the body.[1] Diabetes is on the increase throughout the world and Iran is not an exception.[2] The prevalence of type 2 Diabetes Mellitus (T2DM) varies from 1.2% to 14.6% in Asia, 4.6% to 40% in the Middle East, and 1.3% to 14.5% in Iran.[3] The third national Surveillance of Risk Factors of Non-Communicable Diseases survey reports the rate of T2DM among Iranian adults to have been 8.7% in 2007; also, a 35% increase was found between 2005 and 2011. In 2014, the rate of T2DM in Iran was 11.4%.[4]

Research shows that diabetes mellitus can result in long-term complications in the brain which can adversely affect cognitive functioning.[5] Cognitive disorders in diabetic patients were first noticed in 1992.[1] Based on strong evidence, diabetes mellitus increases the risk of cognitive impairment.[6] Type 2 diabetes mellitus increases the risk of dementia 1.5–2.5 times.[5] However, type 2 diabetes has been associated with cognitive impairment, but few researches have studied this symptom in depth and the influence of diabetes on cognition is a lesser known phenomenon.[1, 7] Cognitive disorders in diabetic patients are accompanied by reduced kinesthetic-mental performance, attention span and executive performance. A variety of factors can account for dementia and cognitive impairment in people with type 2 diabetes mellitus.[5]

Iran is encountered with high prevalence of diabetes mellitus, but the relationship between diabetes mellitus and cognitive impairment has not been reported yet.[8] A study in Shiraz reports that the cognition status of 40.3% of patients with type 2 diabetes is normal, but 44.9% and 14.9% have mild and moderate cognitive impairment, respectively.[9]

Poor control of one's metabolic indexes can increase the risk of neuropathic pain and capillary diseases, retinopathy, and nephropathy.[10] A number of large-scale longitudinal studies report a link between glycemic control and cognitive decline. Early diabetic control can prove helpful in preventing vascular complications, as well as cognitive decline. Although more research is required for the confirmation of the benefits of intensive glycemic control, effective measures that prevent hypoglycemia and hyperinsulinemia can reduce the chances of cognitive impairment.[11]

In the past, the effectiveness of treatment was judged by chances of recovery or failure and death. Today, however, life quality is regarded as an important criterion for evaluating the effectiveness of treatment.[8] Lifestyle-related interventions and timely strict measures can considerably lower the incidence of complications and enhance the diabetic patient's quality of life.[10] One of the important areas in diabetes research is the quality of life of patients. Quality of life includes patients' perceptions of their mental, physical, and social well-being. The significance of a high quality of life has been proved and is considered in diabetes guidelines as a major goal to be achieved.[12]

The findings of many cross-sectional studies show that hyperglycemia causes impairment in the cognitive function. One study reports a 0.14% decrease in the Mini-Mental State Examination (MMSE) score of diabetic patients for every 1% increase in their HbA1c among the dimensions of cognitive function which were found to be affected were psychomotor speed, memory and executive functioning, indicating a significant negative correlation between HbA1c levels and cognitive performance.[11] Reduction in kinesthetic-mental performance, attention span and executive performance are among the cognitive disorders diabetic patients may experience.[13]

Advancing dementia reduces quality of life and adds to the troubles of both patients and their families, thus the necessity of taking steps to prevent the complications of dementia.[11] Besides cognitive impairment and dementia, cognitive disorders associated with diabetes include subtle cognitive changes that can affect the patients' daily activities or

diabetes self-management.[14]

Since self-management by diabetics leads to a better control of their metabolic situation, American Diabetes Association recommends self-management as an important part of self-care.[10] Although several studies show that patients have difficulties with self-management,[15, 16] the patient has the most important role in the daily management of his/her diabetes. Therefore, diabetic patients need to be taught the necessary skills for self-management.[17] According to the National Standards for Diabetes Self-Management Education and Support (DSME/S), all diabetics should participate in DSME programs to acquire the knowledge, skills, and abilities essential for diabetes self-care and DSMS which are needed for continuous self-management, both at diagnosis and later. Improved self-management and better clinical results, health conditions, and quality of life are among the main benefits of DSME/S and should be considered in care plans for diabetic patients.[18]

Problem-solving is a core skill in most models of self-management;[7] it is defined as an individual's "ability to recognize personal, environmental, social, and knowledge-based barriers to regimen management and an ability to implement effective solutions to overcome those barriers."[19]

Based on the review of literature, the aim of various educational techniques, enablement programs, promoting self-management, improving the quality of life and teaching problem-solving is to prevent the symptoms and reduce the mortality rate of diabetes. Studies have proved the effectiveness of each of the above-mentioned approaches; however, individual differences among patients have not been addressed sufficiently.[20, 21] Studies show that diabetic patients suffer from cognitive disorders, but few studies have addressed patients with type 2 diabetes and cognitive impairment.[1]

Promotion of self-care and prevention of symptoms in type 2 diabetes are constantly challenging the health organizations and governments; also, diabetes has widespread influences on patients, their families and societies. Accordingly, this study aimed to determine the effects of the problem-solving technique on the quality of life, self-management profile, and metabolic control indexes in type 2 diabetes patients with cognitive impairment for the first time in Iran.

Materials and Methods

This study was a randomized clinical trial conducted in the largest outpatient clinic in the south of Iran between December 2014 and April 2015. Based on a similar study,[21] considering power: 90%, and α: 0.05, and using Power SSC statistical software and the following formula, at least a 100-subject sample size was determined for the study (50 subjects in each group).

$$N = \frac{\left(Z_{1-\alpha/2} + Z_{1-\beta/2}\right)^2 (S_1^2 + S_2^2)}{(\mu_2 - \mu_1)}$$

α=%5, β=0.1 (power=90%), S_1=1.26, S_2=2.05, μ_1=7.08, μ_2=8.18

Initially, diabetic patients who met the inclusion criteria were selected based on the convenient sampling method; subsequently, the subjects were divided into a case and control group according to block randomization. One patient from the intervention group and three patients from the control group were excluded by the end of the study, the former due to heart attack, and the latter due to withdrawal from the experiments in stage 2 (Figure 1). The study design was developed by an expert statistician who was not involved in measuring the eligibility of the subjects, education of the subjects, and analysis of the results.

The criteria for participating in the study were as follows: being affected by one level of cognitive impairment (weak or medium) by Mini Mental Status Examination (MMSE);[22] being affected by T2DM as confirmed by an endocrinologist; being aged from 30 to 60; having received a sixth-grader's education at least (medical graduates could not participate); the steadiness of their diabetes (they had had

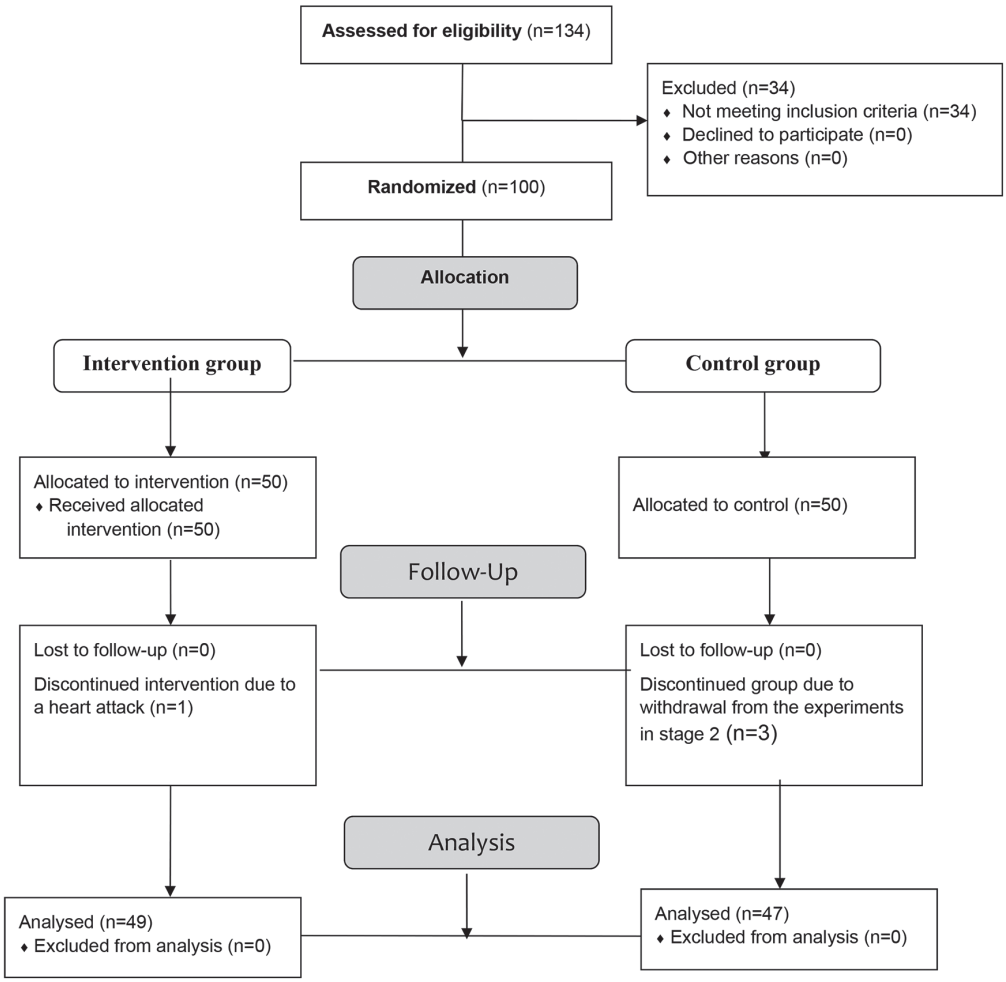

Figure 1: CONSORT flow chart of the participants

the disease for at least a year); not being affected by other cognitive disorders, such as Alzheimer, multiple sclerosis, etc.; speaking Farsi; being able to participate in the classes; not being pregnant; not having participated in organized classes for the diabetes; and giving consent to participate in the study. The criteria for withdrawal from the study were as follows: being affected by a neurologic disease affecting the level of cognition, such as Alzheimer or brain stroke; missing more than two classes; and losing the faculty of one or more limbs due to severe diabetes.

The patients were called on the phone and the objectives of the study were explained to them. Subsequently, they were asked to meet the researcher at an appointed time if they were willing to participate. At the first meeting, the patients were asked to fill out a consent form and MMSE questionnaire. Then, if the patient had cognitive impairment, he/she filled out a quality of life questionnaire,[23] and a self-management profile.[24] Then, their fasting blood sugar level, HbA1c, serum triglycerides, total cholesterol, high density lipoprotein (HDL), and low density lipoprotein (LDL) were checked.

Cognitive disorders questionnaire with a reliability of 0.81 was used as a mini-mental status examination, a measure known for cognitive impairment screening and documentation of cognitive changes that occur over time. It also aimed to assess the potential effects of treatment on cognitive functions. The maximum score of the questionnaire was 30, with scores 21-27, 10-20, and <9 indicating mild, moderate, and severe cognitive impairment, respectively. MMSE

is an instrument which has been shown to be reliable and valid across different cultural and clinical settings. Construct validity of the instrument was measured by the correlation between the MMSE and the Cambridge Cognitive Examination (r=0.94).[22]

The quality of life instrument for patients with diabetes was devised in 2010 in India, especially designed to assess the quality of life of diabetics. The overall Cronbach's alpha of the questionnaire has been reported to be 0.89. The validity of the questionnaire has been verified by content validity. Also, the construct validity of the instrument was determined using exploratory factor analysis. The questionnaire consists of 34 items based on a 5-point Likert scale. The items are divided into eight domains: role limitations due to physical health (6 items), physical endurance (6 items), general health (3 items), treatment satisfaction (4 items), symptoms' bother (3 items), financial worries (4 items), mental health (5 items), and diet satisfaction (3 items). Overall, the score range is from 34 to 170. A score of between 34 and 79 indicates an unsatisfactory quality of life; if the score is between 80 and 125, it is fairly satisfactory, and the scores between 126 and 170 indicate a satisfactory quality of life.[23]

The self-management profile was designed in an American study in 2010. The Cronbach's alpha coefficient for the internal homogeneity of the questionnaire was found to be 0.8. Moreover, the consistency of the questionnaire was tested based on the test-retest method, and the Spearman-Brown coefficient was found to be 0.75. Construct validity was assessed through correlations between measures representing the constructs that were hypothesized to be convergent or discriminant based on the theoretical relationships among constructs.[24] The self-management profile contains 18 items and is designed for patients with T2D (SMP-T2D). The profile addresses 12 constructs and is divided into 4 domains: patient's performance, patient's ease of performance, ease of weight control, and trusting one's abilities to manage diabetes. All SMP-T2D scores were transformed to a 0–100 scale, with equal increments between the responses. Scoring was designed so that higher scores indicate better self-management (as a result, items rating "difficulty of…" are reversely scored and labelled as "ease of…"). Except for the Physical Activity behavior measure, scores for domains that had more than a single item were calculated as the mean of the available items. The measure of Physical Activity behavior consists of 3 items, addressing light, moderate, and vigorous activity. Scoring followed the logic of the Rapid Assessment of Physical Activity (RAPA), where the respondents' scores are categorized into one of four levels of physical activity: sedentary (0=no days of vigorous or moderate activity, and less than 2 days of light activity); underactive, light activity (33.3=no days of vigorous activity with 1–2 days of moderate activity and/or 2 or more days of light activity); underactive, regular activity (66.7=1–2 days of vigorous activity and/or 3–4 days of moderate activity); and active (100=3 or more days of vigorous activity and/or 5 or more days of moderate activity).[25]

The patients' blood samples were checked after they had not eaten for 12 hours. The level of the blood glucose, HbA1c, total serum cholesterol, triglycerides, HDL, and LDL was determined. For the sake of reliability, all the blood samples were taken by the same technician and checked in one laboratory using a single procedure. (HbA1c was measured by Pars Azmoon kit, and FBS and lipid profile were measured by Prestige Automatic Clinical Chemistry Analyser).

After both groups completed the questionnaires and their blood samples were taken, the intervention group was exposed to the empowerment-based problem solving technique. The patients in the control group attended the routine programs, which often took the form of lectures, at the site of the study.

In this study, problem-solving was approached based on the empowerment model.[26] This model lasts six weeks, each

week including a 90-minute meeting. The patients in the intervention group were divided into smaller groups of 10 to 15 members by the researcher to hold the meetings. Each meeting dealt with five main issues: sharing experiences of self-management, discussing the role of emotions, using systematic problem solving, answering clinical questions, and providing feedback. At the first meeting, the objectives of the program and the rules were explained by the researcher, and the patients were informed about the current conditions of their diseases: HbA1c, lipid, blood pressure, and extra weight. The information provided included the normal amount of each substance. The patients were asked to express their concerns or questions regarding the information. Thus, the topic at each meeting was based on the patients' concerns, questions and priorities. At the end of the first meeting, the problem-solving technique was explained based on the five-stage empowerment process. The following sessions started with a discussion of related experiences. The groups met and the researcher acted as the moderator. (To provoke discussion, the patients were asked to brainstorm the ideas). All the teaching sessions were conducted by one of the authors experienced in patient education. This was to ensure consistency in delivering the intervention. Three months after the intervention, all the patients in both groups were reassessed to determine their quality of life, self-management profile, and metabolic control indexes. For ethical reasons, the patients in the control group were informed that they could register for the teaching sessions to learn the educational content offered to the intervention group. Moreover, copies of the educational content that was based on the researchers' review of literature were given to the entire patients.

Data were analyzed using SPSS statistical software, version 16.0. Paired t-test, independent t-test, Wilcoxon, Mann-Whitney and Chi-Square tests were used to compare the differences between the two groups before and after the intervention. Data analysis was conducted by an expert statistician who was blinded to the study protocol.

Before the study was conducted, the Committee of Research Ethics at a University of Medical Sciences approved the study with the code of CT-92-6723. The study participants were also informed about the process of the study and their rights, and they were asked to give their written consent. All the participants were assured that their participation was entirely voluntary and that they could withdraw from the study at any time.

Results

The patients in the study were aged between 30 and 60, with a mean of 51.6 (7.2) years. The type 2 diabetes duration ranged from 1 to 35 years; 49% of the participants had moderate cognitive impairment, and 51% had slight impairment. The patients' demographic characteristics are displayed in Table 1.

After the intervention, the differences between the groups' levels of HbA1c (P=0.02) and HDL (P=0.02) were significant, but those among their fasting blood glucose, total serum cholesterol, triglycerides and LDL were not significant (P>0.05). The results of the experiments of the groups before and after the intervention are shown in Table 2.

Based on the results, the mean difference of the changes in the quality of life (P<0.001) and the four areas of physical endurance (P<0.001), general health (P<0.001), satisfaction with treatment (P=0.01), and mental and emotional health (P<0.001) between the intervention and control groups three months after the intervention was significant.

The differences between the two groups in the area of self-management were as follows: patient's anxiety management (P<0.001), patient's capability in using medicine (P<0.001), healthy eating (P<0.001), weight management (P=0.02), and confidence in one's ability to manage his/her diabetes (P<0.001). In all of the above areas, the mean differences of changes between the intervention and control groups were significant. Table 3

Table 1: Demographic characteristics of patients

Groups / Variable	Control (N=47)	Intervention (N=49)	P value
	N (%)	N (%)	
Gender			
-female	37 (78.72)	36 (73.46)	0.54*
-male	10 (21.27)	13 (26.53)	
Level of cognitive impairment			
-weak	24 (51.06)	25 (51)	0.99*
-medium	23 (48.93)	24 (49)	
Education level			
-pre-diploma	30 (63.82)	32 (65.30)	0.74*
-diploma	11 (23.40)	13 (26.53)	
-university	6 (12.76)	4 (8.16)	
	Mean±SD	Mean±SD	
Age (year)	50.76±7.51	52.59±7.04	0.80**
T2DM duration (year)	7.34±7.91	7.46±6.16	0.15**

*Chi-square; **Independent t-test

Table 2: Comparison of the mean values of FBS, lipid profile and HbA1c in the intervention and control groups

Indexes	Time / Group	Before Intervention Mean±SD	After Intervention Mean±SD	P value With in	P value Between
HbA1c[a]	Control	8.48±1.72	8.34±1.62	0.50*	0.02**
	Intervention	8.90±1.96	8.23±1.56	<0.001*	
FBS[b]	Control	184.72±72.33	171.72±70.69	0.17*	0.28**
	Intervention	175.29±70.27	154.46±63.09	<0.001*	
TC[c]	Control	192.87±43.49	190.13±38.48	0.60*	0.71**
	Intervention	187.29±38.61	187.00±33.18	0.94*	
TG[d]	Control	203.47±77.98	184.11±83.33	0.03*	0.97**
	Intervention	220.45±97.54	201.49±89.77	0.02*	
HDL[e]	Control	46.78±12.91	47.48±12.34	0.68*	0.02**
	Intervention	45.06±11.15	51.10±12.94	<0.001*	
LDL[f]	Control	100.37±28.63	96.36±23.62	0.27*	0.85**
	Intervention	100.22±28.25	94.40±22.71	0.08*	

*Paired t-test (Wilcoxon); **Independent t-test (Mann-Whitney); a: glycosylated hemoglobin; b: fasting blood sugar; c: total cholesterol; d: triglycerides; e: high density lipoprotein; f: low density lipoprotein

shows the patients' quality of life and self-management and related areas before and after the intervention.

Discussion

The objective of this study was to determine the effectiveness of the problem-solving technique on the quality of life, self-management profile and metabolic indexes (fasting blood glucose, HbA1c, triglycerides, total serum cholesterol, HDL, and LDL) of type 2 diabetic patients with cognitive impairment. The findings of the study show that employing the problem-solving technique improves certain metabolic indexes and results in a significant enhancement in certain aspects of the quality of life and self-management in patients with type 2 diabetes and cognitive impairment. Evidently, the features of the intervention in this study, i.e. sharing experiences of self-management in diabetes, discussing the emotional aspects of diabetes, having systematic group interaction toward overcoming problems, raising questions on self-management in diabetes, selecting patients of a single experience related to self-management in

Table 3: Comparison of the Mean values of self- management and quality of life in the intervention and control groups

Variable	Time / Group	Before intervention Mean±SD	After intervention Mean±SD	P value With in	P value Between
Patient behavior domains:					
Monitoring blood glucose	Control	7.58±19.24	10.61±21.95	0.008*	0.89**
	Intervention	15.43±30.26	23.01±35.91	0.01*	
Taking medications as prescribed	Control	62.88±34.20	65.30±32.07	0.32*	0.65**
	Intervention	70.55±30.93	74.90±28.53	0.16*	
Healthy eating	Control	51.02±28.86	50.69±29.91	0.89*	0.42**
	Intervention	51.55±28.41	54.18±30.46	0.33*	
Engaging in physical activity	Control	67.73±33.69	67.37±32.97	0.85*	0.23**
	Intervention	68.02±34.67	76.86±29.82	0.01*	
Anxiety management	Control	50.00±25.00	63.29±25.45	<0.001*	<0.001**
	Intervention	54.08±24.65	84.18±20.85	<0.001*	
Ease of patient's behaviors:					
Monitoring blood glucose	Control	29.78±23.10	38.29±24.91	0.003*	0.20**
	Intervention	28.06±26.82	40.81±29.62	<0.001*	
Taking medications as prescribed	Control	46.80±32.81	53.19±31.11	0.05*	<0.001**
	Intervention	52.04±34.54	78.06±27.03	<0.001*	
Healthy Eating	Control	37.76±23.23	45.21±19.94	0.01*	<0.001**
	Intervention	42.85±28.41	65.30±26.91	<0.001*	
Engaging in physical activity	Control	44.68±27.55	52.65±27.69	0.007*	0.20**
	Intervention	52.55±29.86	65.30±30.54	<0.001*	
Anxiety management	Control	54.78±26.39	62.23±25.99	0.01*	0.63**
	Intervention	52.44±32.46	65.30±33.39	<0.001*	
Ease of managing weight	Control	46.80±27.88	57.44±30.35	<0.001*	0.02**
	Intervention	45.40±30.47	47.95±31.39	0.31*	
Confidence in one's ability to manage one's diabetes	Control	68.80±26.38	64.54±29.82	0.06*	<0.001**
	Intervention	68.71±29.88	79.60±23.38	<0.001*	
Quality of life:					
Total Quality of life	Control	120.57±15.48	128.12±14.77	<0.001*	<0.001**
	Intervention	117.53±18.73	138.02±15.18	<0.001*	
Role limitation due to physical health	Control	22.61±4.98	24.34±5.35	0.01*	0.34**
	Intervention	23.42±4.43	24.32±4.17	0.11*	
Physical endurance	Control	23.46±4.28	22.63±4.72	0.25*	<0.001**
	Intervention	22.20±55.57	24.00±5.14	<0.001*	
General Health	Control	9.74±3.01	10.61±2.71	0.03*	<0.001**
	Intervention	8.32±2.46	12.57±2.02	<0.001*	
Treatment satisfaction	Control	13.82±3.66	14.51±3.76	0.18*	0.01**
	Intervention	14.06±3.68	16.40±3.35	<0.001*	
Symptom suffering	Control	10.59±3.24	11.72±2.66	0.01*	0.34**
	Intervention	10.14±3.33	11.83±2.40	<0.001*	
Financial Worries	Control	12.53±4.15	14.90±3.77	<0.001*	0.55**
	Intervention	13.20±4.50	15.16±3.83	<0.001*	
Emotional/mental health	Control	17.14±3.98	18.06±3.46	0.11*	<0.001**
	Intervention	16.00±4.20	21.63±3.15	<0.001*	
Diet advise tolerance	Control	10.34±2.20	11.31±3.10	0.02*	0.78**
	Intervention	10.38±2.85	11.53±2.93	0.008*	

*Paired t-test (Wilcoxon); **Independent t-test (Mann-Whitney)

diabetes, not only improved certain metabolic indexes, but also enhanced certain aspects of the patients' quality of life and self-management. Similar studies prove that education positively affects the quality of life of patients with type 2 diabetes.[27-29] It is possible that the patients' failure to improve the whole aspects of their quality of life and self-management is due to financial problems.

Obviously, financial problems cannot be eliminated through educational intervention alone, and health care organizations must take measures to deal with patients' financial problems. In a study, the researcher suggested the importance of educational interventions for improvement of diabetes self-efficacy in low-income patients.[29]

Clinicians and health economists have recently studied the relationship between type 2 diabetes and patients' socioeconomic status and how it can influence the lower class.[30]

According to a study, gender, economic status, manner of diabetes treatment and complications related to diabetes mellitus are independent risk factors in many of the health-related subscales of quality of life.[31]

According to a study, training adults with diabetes in coping skills and problem-solving enhanced their care skills, lifestyle behaviors, and quality of life.[32] This is in line with the results of the present study and confirms the positive influence of problem-solving skills on the quality of life. Therefore, to improve the quality of life of patients with diabetes, they should be taught about problem-centered coping techniques. Findings of a study showed that nurse-centered interventions can significantly improve the diabetics' quality of life.[33] However, since the application of the problem-solving technique in the present study is a patient-centered approach and nurses act as advisors, the results of the two studies do not agree.

According to a study, problem-solving skills affect self-management which is an important skill for diabetes to learn.[34] Similarly, the findings of a study showed that the educational program of problem-solving significantly increased self-management of diabetes.[35]

The problem-solving technique did not affect certain aspects of self-management in this study, including control of blood glucose, medication adherence, and physical activity. These results agree with the findings of a study where diet, medication adherence, physical activity and blood glucose self-monitoring were found to be resistant to change.[36] The results of several studies show that patients with social-financial needs are the least successful in diabetes self-management; for instance, they act poorly in dieting, medication adherence, physical activity, and blood glucose self-monitoring.[37]

The mean differences between the two groups were significant only with regard to the indexes of HbA1c and HDL. Thus, the intervention was successful in creating the differences between the groups' metabolic control indexes to a certain extent.

In a study, where the patients were taught self-management according to the method of 5A, significant changes were reported in the level of HbA1c, fasting blood glucose, and HDL; these findings agree with the results of the present study. Researchers also attributed the failure of the intervention to the effect of certain indexes including cholesterol, triglycerides, LDL, and body mass index with the short period of the project, and the resistance of these factors to change.[21]

Based on a study, the highest level of glycosylated hemoglobin occurs in February to March, and the lowest level in November to December. In Hawkins' study, body-temperature-related physiological and metabolic factors were identified as the causes of seasonal differences in glycosylated hemoglobin.[38] Blood checking in the present study was performed at the same time as the above-mentioned studies (the first sampling was performed in January and the next one in April); however, our findings do not agree with the results of the studies referred to above. Accordingly, to ascertain the influence of seasonal changes on glycosylated

hemoglobin, more expert studies are required.

This study had a limitation: the study was conducted on only two groups of type 2 diabetes patients from the same clinic and, therefore, the results of the study may not apply to all diabetes patients.

To date in Iran and other Middle East countries, there is no study conducted on the effect of the problem solving strategy in type 2 Diabetics with cognitive impairment on the quality of life, self-management profiles and metabolic indicators. The findings of the present study are an important contribution to the body of the results of previous studies on the positive influence of problem-solving skills on the quality of life.

Conclusion

Cognitive disorders in diabetic patients are accompanied by reduced kinesthetic-mental performance, attention span and executive performance. Based on the results of the present study, teaching the problem-solving technique to diabetic patients is an effective approach to improve their metabolic indexes control, their life quality and self-management skills; it is also used to prevent the occurrence of serious problems and the ensue the costs due to the disease. Accordingly, it is suggested that a protocol should be developed to promote this technique in diabetes clinics. Moreover, the patients mentioned that the technique had improved their perspectives on life; such effect can be studied by other researchers.

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