

The effects of cognitive behavioral therapy on selected physical, physiological parameters, exercise and nutritional behaviors in diabetic persons

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Abstract. – OBJECTIVE: Due to the high prevalence of diabetes in the world, it seems that one of the most important strategies to prevent and treat this disease are lifestyle changes. The present study aimed to investigate the effects of cognitive behavioral therapy on selected physical and psychological parameters, exercise, and nutritional behaviors in diabetic patients.

PATIENTS AND METHODS: This was a cross-sectional study of volunteers with type 2 diabetes. Patients were randomized into two groups: an intervention (n=32) and a control group (n=31). The Beck Physical Activity Questionnaire was used to assess physical activity in combination with the Beck Depression Inventory and the Pittsburgh Sleep Quality Index to assess the levels of depression and the quality of sleep. Cognitive behavior therapy (CBT) training consisted of six sessions of cognitive behavioral therapy interventions. The intervention consisted of a face-to-face individual counseling session. The patients received a special diet according to their basal metabolic rate (BMR). At all sessions, dietary advice was reviewed, and during the treatment period, they were asked to record their diet and physical activity. Body composition and blood samples were measured before and after three months of the experiment for both groups.

RESULTS: Blood glucose, blood lipid profiles (except high-density lipoprotein), lifestyle, behavior patterns and body composition were significantly improved following CBT intervention ($p \leq 0.05$).

CONCLUSIONS: CBT can play a key role in improving physiological and psychological parameters in diabetic patients.

Key Words:

Cognitive behavioral therapy, Diabetic persons, Exercise, Nutrition.

Introduction

The automatization of work and an increasingly sedentary lifestyle have gravely affected the present generation¹. Obesity is considered a global epidemic influenced by environmental and genetic factors^{2,3}. Complications of obesity including type 2 diabetes, psychosocial complications, and cardiovascular and respiratory diseases negatively affect the community^{4,5}.

Obesity is one of the most common metabolic syndrome disorders and has become a major global public health concern in the 21st century^{6,7}. The burden of diabetes is higher in developed than in developing countries⁸. It is predicted that the prevalence of diabetes is expected to grow until 2030⁹. The population aged between 45-64 years is the most affected and presents the peak of social and economic activity¹⁰. Therefore, a high prevalence of diabetes in the working population adversely affects the economy¹¹. However, in developed countries, diabetes is most prevalent in the older population (over 65 years)¹². The rapid progress of urbanization, changes in dietary habits, the decline in physical activity, and the rise

of obesity have been important factors in the increasing prevalence of diabetes^{1,13}.

Extensive researches suggest that a combination of lifestyle measures, including maintaining a body mass index (BMI) of 25 kg/m² or less, adhering to a diet containing high amounts of vegetable fiber, unsaturated fats, low levels of saturated fats and sugars, and regular exercise can reduce the risk of diabetes by up to 90%^{14,15}. Exercise training programs have a significant impact on the physiological, psychological, and biochemical mechanisms^{1,16}. The effectiveness of exercise on metabolic processes with increased insulin sensitivity, improved glucose tolerance, and weight loss has been well documented^{17,18}.

Diabetes is often associated with psychological problems and, unfortunately, diabetes control exacerbates patients' psychological problems. It is advisable to have an optimal self-management regime to better control blood glucose levels¹⁹. This causes patients to fall into a faulty cycle because diabetes interacts with the existing beliefs, thoughts, feelings and behaviors of the patient^{20,21}. Therefore, it is important to manage the emotions of those affected.

Although many guidelines are available for diabetes management, little research has been focused on the psychological impact of these challenging conditions²². It is clear that psychological therapy is an integral part of a comprehensive approach to diabetes management. Despite its importance, little attention has been given to the subject by health researchers²².

Today, cognitive behavioral therapy (CBT) is one of the treatments used to treat anxiety, depression, and mental and physical health problems²³. This treatment is based on a combination of cognitive and behavioral approaches²³ and helps patients to increase their coping skills and their resilience to emotional distress²⁴. It was shown that CBT can decrease the symptoms of anxiety, depression, and hopelessness²⁵⁻²⁷.

Overall, diabetes prevention and controlling strategies are more focused on physical activity and nutrition control, and less on the psychological state of the affected patients²⁸. However, there are no clear guidelines how health care teams should promote a healthy lifestyle for people with diabetes²⁹. Therefore, the main purpose of this study was to investigate the effects of CBT on selected physiological parameters, body composition, exercise and nutritional behaviors in diabetic patients. We hypothesized that we could enhance and support the treatment of this disease by devel-

oping the habit of regular physical activity and a proper diet with the aid of CBT.

Patients and Methods

Ethical Approval

Before conducting the study, written informed consent was obtained from all the patients included in the study. The study has been approved by the Ethical Committee of Imam Khomeini International University (Code: 17628).

Patients

This was a cross-sectional study. A total of 84 eligible patients (Iran; Qazvin) with type 2I diabetes were included in the study by convenience sampling method. They were informed about the study through social networks (Telegram, WhatsApp and Instagram) and continued the selection process in medical centers. 63 out of 84 volunteers were selected after the screening tests based on the inclusion criteria.

Inclusion criteria were a diagnosis of type 2 diabetes, Beck Depression Index (BDI) of ≤ 13 , Pittsburgh Sleep Quality Index (PSQI) of ≤ 5 , physical activity range of 5-15 according to the Beck Physical Activity Questionnaire (BPAQ), BMI of 25-30 kg/m², aged between 35 and 50 years, and functional independence in daily activities. Exclusion criteria were: more than one absence in CBT, pregnancy, and lactation. Patients were randomized into two groups: intervention (n=32) and control (n=31). After the initial assessment, the intervention group received the CBT intervention, while the control group did not receive any behavioral intervention.

Procedure

The BPAQ was used before and after the study period to assess the physical activity of both groups. The reported reliability of the test, measured by the Interclass Correlation Coefficient, was 0.95 for occupational activity, 0.93 for sports activity, and 0.77 for leisure activity³⁰. The BDI and the PSQI were used to assess depression and sleep quality, respectively. Body mass was measured using the Seca scale with minimal clothing and without shoes (Seca 770; Seca GmbH & Co, Hamburg, Germany). Body height was measured with a non-elastic tape measure with an accuracy of 0.5 cm (Seca 201, Seca GmbH & co. Hamburg, Germany). Waist and hip circumferences (WHR) were measured with a non-stretch tape measure,

Table I. Research design.

Study phases	Pre-test	Intervention (six sessions of CBT)	Post-test
Groups	Measurement of physiological and behavioral patterns	Educational Plans and Follow-up	Measurement of physiological and behavioral patterns
CBT	+	+	+
Control	+	N/A	+

N/A: not applicable; CBT: cognitive behavioral therapy.

the Gulick II (Lafayette Instrument Co, Lafayette, IN, USA). The research design can be seen in Table I.

Intervention

CBT training consisted of six sessions of CBT interventions:

- First session: the investigators provided information regarding the prevalence, causes and consequences of overweightness, obesity, and diabetes. At the end of the first session, patients were asked to write down the most important reasons for their body-mass loss.

- Second session: the investigators presented the behavioral strategies to change eating habits, self-care, strategies for eating management (e.g., dietary choices, shopping, cooking, reduced consumption of unhealthy snacks and fats). They were given a list of foods to determine their eating habits. The patients were then asked to write down stimuli that could lead to erroneous habits.

- Third session: The investigators explained the differences between hunger and craving to the patients. The patients explained the potential problems and obstacles of their diet plan and addressed them with their therapist. The habit of doing physical activity was also evaluated and a suitable exercise program was suggested. The patients were asked to indicate the difference between hunger and craving and to document their feelings and behavior patterns during their periods of hunger and craving as well as its severity and weakness.

- Fourth session: The investigators explained the social, mental, and environmental initiation symptoms. At this point, environmental engineering and modification to tackle excess were explained. At the end of the session, the patients were asked to come up with solutions to improve their surroundings.

- Fifth session: The investigators explained how pleasant and unpleasant emotions cause cravings.

New ways to enjoy life with an emphasis on physical activity were introduced. At the end of this session, a list of activities that would bring happiness and enjoyment was prepared.

- Sixth session: Values and social eating habits were discussed, and training was provided. An explanation of false beliefs was presented. Patients were instructed to maintain and manage weight to achieve a specific goal and establish a weight monitoring system. They were asked to document their thoughts and feelings when faced with adverse conditions.

The patients of both groups received a special diet according to their BMR.

Diet Control

The diet consisted of six meals per day including three main meals and three snacks for carbohydrate distribution between meals. This diet ensured a minimal increase in blood glucose after each meal and prevented the occurrence of hypoglycemia due to drug use in diabetics. The individualized diet was separately adjusted for each individual according to the condition and physical analysis of the individual. The caloric content of carbohydrates was 52-53% of the total calories, 17-18% of protein and the rest were allocated to fats.

Dietary advice was reviewed during all sessions. The patients were asked to document their diet and physical activity during the whole treatment period. The follow-up was executed through social media (WhatsApp, Telegram and Instagram), phone calls, and consulting sessions in the Sports clinic. All sessions were supervised by a psychologist.

Blood Sampling

Using a centrifuge, the serum was separated from the blood and placed inside the special cups of the autoanalyzer. Blood glucose (fasting blood sugar), total cholesterol (TC), low density lipo-

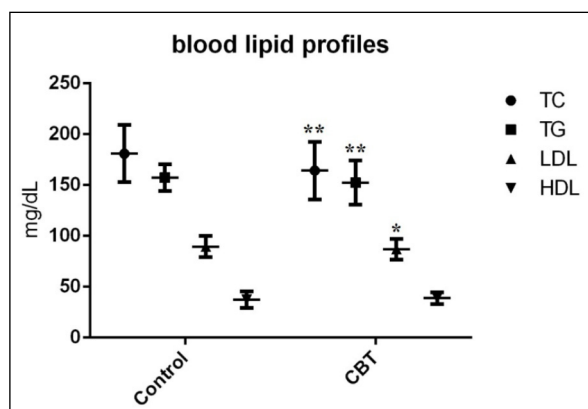


Figure 1. The effect of CBT on blood lipid profiles.

protein (LDL), high-density lipoprotein (HDL) and triglyceride (TG) were evaluated prior to and after interventions by a biochemical kit (Bionic®, Germany).

Statistical Analysis

The statistical analysis was performed using the SPSS v21.0 software (SPSS Corp., Armonk, NY, USA). Data is presented as mean ± SD in the table and the text. The data was analyzed using the analysis of covariance (ANCOVA) test. Post-hoc tests of Bonferroni were used for mean comparison. A significant difference was set at $p \leq 0.05$.

Results

The obtained values showed normal data distribution with kurtosis and skewness being between -1 and +1. Hence, parametric methods were used for data analysis. The results of the independent *t*-test before intervention showed no significant

differences between any of the research contextual variables ($p > 0.05$), showing homogeneity of the subjects in the corresponding randomized groups. The individual characteristics of the participants are presented in Table II.

Table III shows the results of ANCOVA in each sub-scale. Covariance adjusted the effect of the confounding variables in the pre-test by statistical methods. Figure 1 shows the post-hoc test for comparisons of the means after intervention.

The results of post-hoc test are indicated in Figures 1-4. As suggested, all factors including FBS, TC, TG, LDL, lifestyle, behavior patterns and body composition were significantly improved following CBT intervention ($p \leq 0.05$).

Discussion

The main goal of the present study was to investigate the effects of CBT on life habits, including the level of physical activity and eating habits

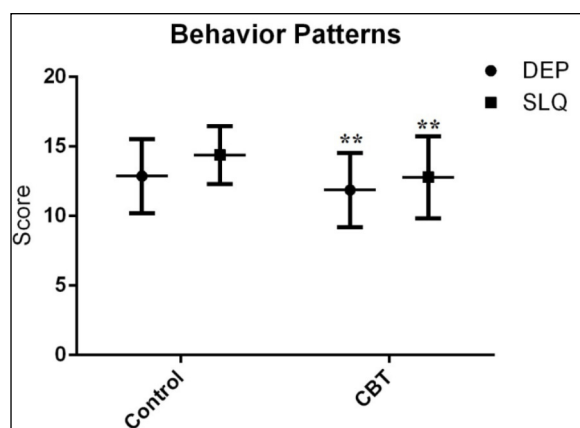


Figure 2. The effect of CBT on behavior patterns.

Table II. Individual characteristic of the patients.

Group	CBT	Control
N	31	31
Male/female	14/17	10/21
Age (year), mean (SD)	44.45 (6.91)	43.03 (6.31)
Body height (cm), mean (SD)	170.81 (10.56)	168.68 (11.58)
Body weight (kg), mean (SD)	74.74 (9.42)	75.26 (9.24)
BMI (kg/m ²), mean (SD)	25.69 (3.06)	26.46 (2.07)
WHR (Ratio), mean (SD)	0.89 (0.07)	0.89 (0.06)

BMI, body mass index; WHR: waist hip ratio; CBT: Cognitive behavioral therapy.

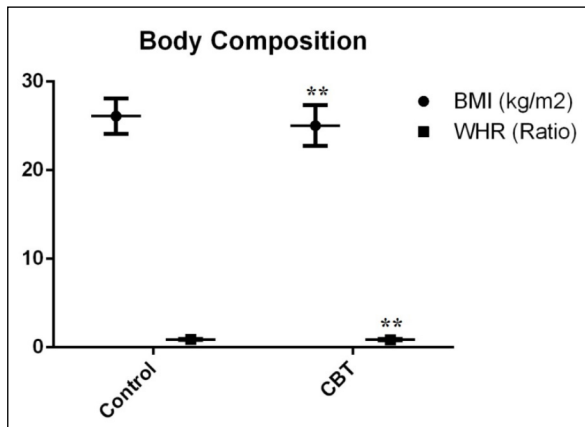


Figure 3. The effect of CBT on body composition.

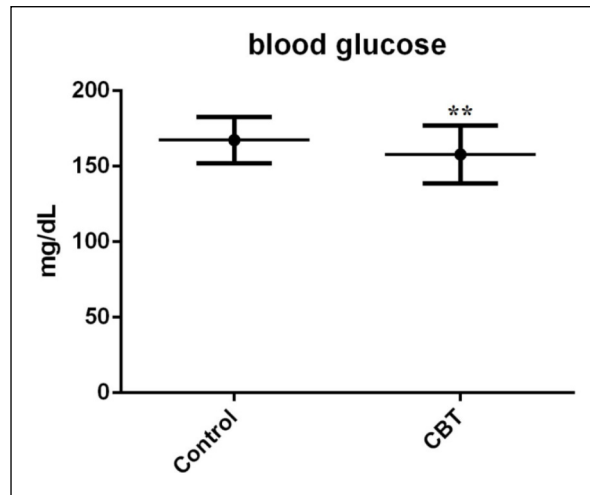


Figure 4. The effect of CBT on blood glucose profiles.

in diabetic patients. The present study showed a decrease in blood glucose and blood lipid profiles (except HDL) as a result of an improved lifestyle, behavior patterns and body composition, which proves the effectiveness of CBT. Physical activity and exercise along with a healthy diet proved to be a cornerstone of diabetes management. Consistent with our study, several reviews^{31,32} and meta-analyses^{33,34} demonstrated that increased physical activity and/or exercise level produces a significant improvement of glucose control in people with type 2 diabetes. Our patients experienced a significant improvement in the performance of physical activities. Therefore, a reduction in blood lipid profiles can be expected in the present study. On the other hand, it is expected that nutritional behavior, especially carbohydrate

intake, was significantly reduced in the intervention group. Since carbohydrate intake has a negative effect on raising blood sugar in people with diabetes, this decrease in consumption has a direct effect on the reduction of the blood glucose in patients. As mentioned in the results section, the blood glucose decreased significantly following the CBT intervention. Regarding the factors related to lifestyle, it was observed that the amount of physical activity, carbohydrate and daily calorie intake were significantly improved in the intervention group compared to the control group. In addition, behavioral patterns, including depression and sleep quality, improved significantly in the intervention group, as did body composition, BMI and WHR.



Figure 5. The effect of CBT on lifestyle.

Table III. Covariance test results for group comparison.

Sub scales		Source	SS	df	MS	F	p-value	Effect Size
FBS		Intergroup	4.53	1	4.53	21.78	0.000	0.270
Blood lipid profiles	TC	Intergroup	6.39	1	6.39	24.86	0.000	0.296
	TG	Intergroup	2.94	1	2.94	18.53	0.011	0.239
	LDL	Intergroup	0.70	1	0.70	6.88	0.000	0.104
	HDL	Intergroup	0.61	1	0.61	0.56	0.456	0.009
Lifestyle	PA	Intergroup	1615.84	1	1615.84	37.81	0.000	0.391
	CI	Intergroup	601230.1	1	601230.1	20.07	0.000	0.254
	CHO	Intergroup	96123.56	1	96123.56	153.49	0.000	0.722
Behavior patterns	DEP	Intergroup	333.16	1	333.16	102.68	0.000	0.635
	SLQ	Intergroup	139.68	1	139.68	35.56	0.000	0.376
Body composition	BMI	Intergroup	37.60	1	37.60	49.65	0.000	0.457
	WHR	Intergroup	0.01	1	0.01	30.72	0.000	0.342

TC: total cholesterol, TG: triglyceride, LDL: low-density lipoprotein, HDL: high density lipoprotein, PA: physical activity, CI: Calorie intake, CHO: carbohydrate, DEP: depression, SLQ: sleep quality, BMI: body mass index, WHR: waist hips ratio, FBS: fasting blood sugar.

It should be noted that there is a direct relationship between physical activity and depression levels^{1,13}. Also, the relationship between physical activity and sleep quality has been explored in other studies^{35,36}. By increasing the amount of physical activity, improvements in the quality of sleep can be expected. Decreased percentage of body fat and visceral fat can be attributed to the increased physical activity in the intervention group. The elevated physical activity resulted in a lower body fat percentage, which is consistent with current studies^{37,38}.

The assumption of CBT is based on the the way people think affects their behavioral choices. For example, when people have difficulties in managing their blood sugar and diet, cognitive distortions in people with low self-control lead to frustration. Hence, they abandon medical interventions, and their condition worsens. As a result, CBT increases the readiness of patients with diabetes to cope with their problems and helps them with their resolution. It should be noted that the use of such psychological therapies facilitates the recovery process of patients with medical problems, such as diabetes. Such psychological treatments improve the patients' quality of life³⁹.

Our results are inconsistent with findings of the previous study⁴⁰ that found no significant effects of psychological interventions for diabetic patients. One of the reasons for the inconsistency of the results could be attributed to the different duration of the interventions. A study⁴¹ suggested that six months of CBT had no significant effect

in newly diagnosed type 1 diabetes patients, however, a better adjustment was observed at nine months although better glycemic control was not measured.

There are some limitations to this study. Firstly, the sample size was small. Hence, more studies with a larger sample size should be conducted to verify these results. Secondly, since CBT is usually a long-term exploratory approach aiming to resolve unconscious conflicts, long follow-ups are required in future studies to monitor the physical and psychological outcomes.

Conclusions

It can be concluded that CBT could play a key role in improving selected physiological and psychological parameters by focusing on sustainable lifestyle changes of diabetic patients. In future practice, it would be ideal if CBT could become an integrated aspect in the overall diabetes management.

Conflicts of Interest

All authors declare that they have no conflict of interest.

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Ethical Approval

The study has been approved by the Ethical Committee of Imam Khomeini International University (Code: 17628).

Informed Consent

Before conducting the study, written informed consent was obtained from all the patients included in the study.

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