ORGINAL ARTICLE

Effect of Mindfulness-Based Cognitive Therapy on Cognitive Emotion Regulation, Perseverative Thinking, and Glycemic Index in Patients with Type 2 Diabetes- A Trial Study

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Abstract

Objective: Type 2 diabetes (T2DM) is a chronic disease associated with many psychological complications, which require psychological interventions. This study aimed to examine the effect of mindfulness-based cognitive therapy (MBCT) on cognitive emotion regulation, perseverative thinking, and glycemic index in patients with T2DM

Materials and Methods: This quasi-experimental study was done on T2DM patients visiting Yazd diabetes center in 2019, 30 men and women were randomly divided into experimental (n=15) and control (n=15) groups. The experimental group received 8 sessions (90 minutes) of MBCT and the control group received no interventions. In the pretest and posttest phase, data were collected using the cognitive emotion regulation questionnaire (CERQ), Perseverative Thinking Questionnaire and fasting blood sugar test. Data were analyzed in statistical package (SPSS 21) using multivariate analysis of covariance.

Results: Results showed a significant difference in mean scores of cognitive emotion regulation (F= 9.866 & *P*-value= 0.0001), perseverative thinking (F= 13.745 & *P*-value= 0.0001), and fasting blood sugar (FBS) (F= 3.679 & *P*-value= 0.034) in the experimental group before and after the intervention.

Conclusion: Based on findings of the study MBCT by specialists in public and private centers can help improve cognitive emotion regulation strategies, perseverative thinking, and ultimately blood sugar control in patients with T2DM.

Keywords: Mindfulness-based cognitive therapy, Cognitive emotion regulation, Perseverative thinking, Fasting blood Sugar, Type 2 diabetes

Introduction

Diabetes mellitus (DM) refers to a group of common metabolic disorders that share the phenotype of hyperglycemia. Depending on the etiology of the DM, factors contributing to hyperglycemia include reduced insulin secretion, decreased

glucose utilization, and increased glucose production. Hypoglycemia is most commonly caused by drugs used to treat DM that can cause serious morbidity; if severe it can be fatal (1,2).

In 2015, it was estimated that there are 285 million adults with diabetes worldwide. It is estimated to grow to more than 438 million people by 2030 (3). As a Middle Eastern country, Iran has also been affected by this problem and due to the growing trend of the elderly population in Iran, the disease is expected to increase rapidly, such that 14% to 23% of adults over 30 years of age suffer from diabetes or display impaired insulin tolerance (4). Type 2 diabetes (T2DM) has long-term and short-term complications. It has wide-ranging effects on patients' lives due to physical complications such as retinopathy, nephropathy, neuropathy, and cardiovascular diseases (5). T2DM is strongly linked to lifestyle factors with very strong behavioral and emotional components such that some scholars such as Glasgow (1997) consider it a behavioral issue (6). Social and psychological factors play an important role in diabetes management and control. Since diabetes can affect people's emotional processing, it seems that cognitive emotion regulation is one of the factors that have been less studied by the researchers regarding the psychological aspects of T2DM (7). Cognitive-emotion regulation is a kind of cognitive coping strategy. Emotion regulation requires a good interaction of cognition and emotion to deal with negative situations, because individuals interpret each event when encountering it and cognitive interpretations determine the individuals' reactions (8). Regulation of emotion refers to the processes whereby individuals monitor, evaluate, and modify their emotions (9). It is one of the important factors in psychological well-being and plays an important role in coping with stressful life events (10).

In a study by Alizadeh and Pour Sharifi (2016), 24 patients with T2DM underwent MBCT. Results showed a significant difference between the experimental and control groups in using cognitive emotion regulation strategies in the posttest and follow-up phase (7). A study by Rosenweig et al. (2017) on the effectiveness of MBCT on diabetic patients, showed that mindfulness interrupted or reduced one's psychological response to stressful stimuli and was effective in improving blood sugar control in diabetic patients (11).

Perseverative thinking is another variable that may be associated with cognitive emotion regulation in diabetic patients. As a common feature of the human mind, it includes self-attributes derived from subjects, events, and behaviors that evoke a negative meaning in this mindset can limit the call to reality. Perseverative thinking states that natural and everyday events imply a meaning to a person the intensity of which varies according to each person's interpretation (12,13).

Ehring & Watkins (14) define perseverative thinking as a type of thinking about a person's problems or negative experiences composed of three dimensions of repetitiveness; intrusiveness, difficulties with disengagement, and two main features of rumination and worry. Perseverative thinking, which is highly correlated with emotional factors, is defined in particular by rumination, which is a central feature of concern, as a result of which perseverative thinking has emerged as a meta-diagnostic process that exhibits the same characteristic in most disorders (15). Perseverative thinking refers to people's cognitive assessment of their lives, so any impairment in cognitive assessment may challenge its concept (16-18). In a study examining perseverative thinking in perfectionism and negative emotions, Pereira et al. (19) showed that perseverative thinking mediates the relationship between emotional disorders. In a study, Mills et al. (20) found significant associations between perseverative thinking, psychological distress, and difficulties of emotional regulation.

The third wave psychotherapies, known as postmodern psychotherapies, believe that

cognitions and emotions must be taken into account in the conceptual context of phenomena (21). Because of the specific nature of diabetes, one of the psychological interventions that can affect cognitive emotion regulation and perseverative thinking in these patients is MBCT (22). MBCT is a short-term (8-session) psychotherapy based on the mindfulness-based stress reduction model developed by Kabat-Zinn that incorporates some elements of cognitive therapy (23). It has been investigated in clinical populations and the results indicated its impact on the treatment of mood disorders, depression with suicidal ideation, anxiety disorders, chronic pain, and cancer (24). In the domain of diabetes domain, the effectiveness of mindfulness-based interventions improved the mental health and well-being of these patients (25). Results showed that MBCT can improve cognitive emotion regulation (7), reduce depression (26), emotional problems (27,28), blood pressure (29), disturbing thoughts, and improve sleep quality (30) in patients with diabetes. No research has been conducted on the effectiveness of MBCT on perseverative thinking in patients with T2DM. Therefore, despite the impact of psychological interventions such as mindfulness on chronic diseases such as diabetes, further research in this area seems necessary. Considering this and the role of emotions and feelings as the psychological dimensions of diabetic patients that are less considered by experts, the present study was designed to determine the effectiveness of MBCT on cognitive emotion regulation, perseverative thinking, and glycemic index of patients.

Materials and Methods

This study was a quasi-experimental study with the statistical population consisted of all male and female patients with MBCT between 30 to 60 years old visiting Yazd Diabetes Center in the first two weeks of (May, June, July) 2019. Among patients visiting the center, 30 of them were selected through convenience sampling and simple random sampling signed to experimental (n= 15) and control (n= 15) groups. Inclusion criteria were the ability to read and write, T2DM (for more than one year), age between 30 to 60 years old, were willing to participate in the study, absence of other physical illnesses (by a doctor), and lack of mental disorders (by a psychologist). Exclusion criteria were physical or psychological injuries, other types of diabetes, insufficient literacy, and unwillingness to continue treatment. The experimental group received 8 MBCT sessions for 90 minutes in (Clinic Salar) and the control group received no interventions.

Research instruments

A: Emotion Regulation Questionnaire (ERQ)

Cognitive Emotion Regulation Questionnaire (CERQ) was developed by Garnefski, Kraaij, and Spinhoven in 2001 with 9 subscales including acceptance, positive refocusing, refocus on planning, positive reappraisal, putting into perspective, self-blame, rumination, catastrophizing, other-blame in 36 items (31). The answers to these items are scored from never to always on a Likert scale. This questionnaire has two strategies, i.e. adaptive cognitive emotion regulation and maladaptive cognitive emotion regulation. Adaptive cognitive emotion regulation strategies comprise 16 items with scores ranging from 1 to 80; maladaptive cognitive-emotional regulation strategies have 20 items with scores ranging from 1 to 100. The reliability of this scale was confirmed by Amin Abadi, Dehghani, and Khodapanahi (2011) using Cronbach's alpha of 0.81 for the whole scale as well as adaptive cognitive emotion regulation subscales. It was between 0.64 and 0.82 for maladaptive cognitive emotion regulation (32). Cronbach's alpha coefficient was also calculated in the sample under study which was 0.83, 0.76, and 0.79 for the adaptive cognitive emotion regulation and the two subscales of maladaptive cognitive emotion regulation, respectively.

B: Perseverative thinking questionnaire

Ehring, Zestche, Weidacker, Wahl and, Ehlers developed a perseverative thinking questionnaire in 2010 in the three subscales of ruminative negative thinking, perceived unproductiveness, and capturing mental capacity by repetitive negative thoughts in 15 items. The answers to these items are scored from never to always on the Likert scale. So, the scores are ranged between 0 and 60. High scores indicate a high volume of repetitive negative thoughts in the patient. Reliability of this scale was confirmed by Cronbach's alpha of 0.95, 0.94, 0.68, and 0.69, respectively for the whole scale and the three subscales of ruminative negative thinking, perceived unproductiveness, and capturing mental capacity by repetitive negative thoughts (33). Cronbach's alpha coefficient was also calculated in the sample under study which was 0.91, 0.88, 0.72, and 0.75 for the whole scale and three subscales of ruminative negative thinking, perceived unproductiveness, and capturing mental capacity by repetitive negative thoughts.

C: Fasting Blood Sugar (FBS) test

As the name suggests, in the FBS test, the blood sample is taken from the fasting patient which is less than 100 mg in normal samples. FBS from 100 to 125 mg/dL was considered prediabetes and higher 125 mg/dL w diabetes. (34).

To conduct the study, after determining the research objectives, adhering to ethical principles, and selecting the statistical population, receiving the introduction letter from Yazd University and referring to the Khani Diabetes Center. The participants in both groups filled the CERQ and perseverative thinking questionnaire and performed FBS test. Then, the experimental group received 8 mindfulness-based group cognitive therapy sessions (during two months for 90 minutes in each session) based on the book The Mindful Way through Depression by Mark Williams, Teasdale, Segal, and Kabat-Zinn (35) and the book Mindfulness Based Cognitive Therapy by Crane (36). The control group received no intervention. Following the sessions, CERQ and perseverative thinking questionnaire with (FBS) were again performed on the two groups as a posttest.

Data were analyzed in SPSS 23 using multivariate analysis of covariance.

Ethical considerations

This article is the result of a master's thesis with an ethics code IR.YAZD.REC.1399.010 and proposalcode1462514

Table 1. Summary of MBCT session summary

Session	Summary
First session	Introducing members to each other, defining group rules and objectives, providing general explanations for MBCT and the relationship between diabetes and psychological factors, intrusive guidance, practicing to have raisins, and giving home assignments.
Second Session	Assessing previous session assignments and barriers to implementing them, physical review meditation, three minutes of breathing space practice with mindfulness, focusing on daily activities, giving home assignments.
Third session	Daily review and assessment of assignments, defining mindfulness with meditation, mindful walking, listing pleasant events, diabetes acceptance, and giving home assignments.
Fourth session	Daily review and assessment of assignments, staying at present, 30 minutes of meditation, awareness of breathing, voice, thoughts, and body, three-minute breathing, giving home assignments.
Fifth session	Daily review and assessment of assignments, unconditional acceptance of thoughts, writing negative thoughts and emotions resulting from them, interruption of negative thoughts, explaining the role of negative thoughts in psychiatric injury, three-minute exercise, and body checkup, giving home assignments
Sixth session	Daily review and assessment of assignments, three minutes of breathing space, 30-minute physical meditation, thoughts and voices, expressing the thoughts and feelings of clients during practice, giving home assignments
Seventh session	Daily review and assessment of assignments, descriptions of emotion regulation, practicing having raisins, sitting meditation with mindfulness, staying at present, giving home assignments
Eighth session	Daily review and assessment of assignments, using the information to cope with future moods, physical meditation, distribution of evaluation forms and group feedback from the intervention and finally ending sessions practicing to have raisins.

Results

Thirty patients with diabetes aged between 30 to 60 years old participated in the study with demographic data including gender and marital status presented in table 2.

Mean and standard deviations of cognitive emotion regulation, perseverative thinking, and blood sugar in patients with diabetes in the experimental and control groups are presented in Table 3. Results of ANOVA test showed no significant difference between experimental and control groups in the pretest phase in variables of cognitive emotion regulation (F= 0.057, *P*-value= 0.944), referential thinking (F= 0.014, *P*-value= 0.986) and blood sugar (F= 1.215, *P*-value= 0.307).

Comparison of means shows that by controlling pre-test scores of emotional cognitive regulation, referral thinking and blood sugar, people with diabetes who received training in MBCT (experimental group) had significantly lower scores. So referral thinking, blood sugar variables and higher scores in emotional cognitive regulation variables in control group. These results reflect the effectiveness of MBCT in lowering blood sugar and referential thinking and increasing emotional cognitive regulation of people with type 2 diabetes.

Before analyzing the data, assumptions were examined by multivariate analysis of covariance. Results of Kolmogorov-Smirnov Test were not significant for any of the experimental and control group variables in the pretest and posttest phases (*P*-value> 0.05), so the assumption of normality was confirmed.

Results of Box's M test and Levene's test were also insignificant (*P*-value> 0.05). Therefore, the assumption of the equality of covariance matrices and equality of variances was confirmed. In addition, the results of Bartlett's test for sphericity were also significant (*P*-value> 0.05), so there was a significant correlation between the dependent variables. Multivariate analysis of covariance can be used in this study, given the research assumptions.

Multivariate analysis of covariance was used to evaluate the effectiveness of MBCT on cognitive emotion regulation, perseverative thinking, and blood sugar in patients with type 2 diabetes. The results are presented in table 3. Results showed that MBCT significantly increased cognitive emotion regulation (F= 9.866, *P*-value< 0.0001), reduced perseverative thinking (F= 13.745, *P*-value< 0.0001), and reduced blood sugar (F= 3.679,

Table 2. Frequency of demographic variables in experimental and control groups

Variable		Frequency in experimental group	Percentage in experimental group	Frequency in control group	Percentage in control group
Gender	Male	4	26.66	5	33.33
	Female	11	73.33	10	66.66
Marital status	Single	1	6.66	1	6.66
	Married	14	93.33	14	93.33

Table 3. Descriptive indices of research variables in experimental and control groups

Variable	Group		Mean & SD
Cognitive emotion regulation	Experiment	Pretest	160.6 (±30.55)
		Posttest	113.87 (±31.90)
	Control	Pretest	103.13 (±16.50)
		Posttest	104.67 (±15.91)
Perseverative thinking	Experiment	Pretest	22.80 (±11.20)
		Posttest	18.80 (±10.12)
	Control	Pretest	23.33 (±11.02)
		Posttest	23.20 (±10.61)
Blood sugar	Experiment	Pretest	186.13 (±31.93)
		Posttest	175.67 (±27.79)
	Control	Pretest	188.80 (±36.58)
		Posttest	186.80 (±33.30)

P-value< 0.34) in patients with type 2 diabetes. The statistical power of the test indicates that the accuracy of the test is 0.97% in cognitive emotion regulation, 0.99% in perseverative thinking, and 0.64% in blood sugar. In addition, according to Eta squared, 0.839% of the variance of cognitive emotion regulation, 0.481% of the perseverative thinking variance, and 0.345% of the variance of blood sugar in T2DM are due to the effects of MBCT.

Discussion

This study aimed to examine the effect of MBCT on cognitive emotion regulation, perseverative thinking, and glycemic index in patients with T2DM. Findings indicated that MBCT is effective in cognitive-emotional regulation in patients with T2DM. These findings were in line with the results of some studies (7,11,37,38).

In explaining the above result, the fundamental conscious mind, which is based on the reception of unpleasant thoughts and various emotional states, dramatically enhances one's ability to control the influence of thoughts and emotions and allows one to experience a wide range of thoughts and emotions, and experience emotions in the mind without experiencing emotional disturbance (39). This ability prevents intrusive thoughts from becoming self-inflicted to create the previous intellectual overload for the individual and turning into a disturbance. According to Kabbat-Ziin 2003 (40), a judgment-free observation in the mind reduces emotional responses. So practicing mindfulness skills increases patients' ability to endure negative emotional states and increases their ability for effective coping. Since patients with T2DM live in stressful situations, they have difficulty regulating their emotions. Using mindfulness-based training, they can cope with negative emotions of the illness and seek to represent it mentally in their lives, instead of avoiding it and adopting more adaptive strategies. The third wave psychotherapies, including MBCT, believe that cognitions and emotions must be taken into consideration in the conceptual context of phenomena (41). Since the physiological issues related to the disease and lifestyle of patients with type 2 diabetes are different from other chronic diseases as well as conditions such as rejection, susceptibility to hyperglycemia, need for insulin injection, diet restriction and need for being meticulously and continually cared for, MBCT helps these patients change cognitions and emotions so that they can benefit from consistent cognitive emotion regulation strategies. Patients with diabetes deal with stressful events with optimism and confidence by learning mindfulness skills, view events as controllable and generally use their information to

Table 4. Bonferroni post hoc test results and multiple comparisons of dependent variable sizes

Variable	Group (1)	Group (2)	Mean difference	*P*-value
Cognitive emotion regulation	Experiment	Control	5.80	0.001
Perseverative thinking	Experiment	Control	-3.91	0.0001
Blood sugar	Experiment	Control	-8.49	0.031

Table 5. Results of covariance analysis of the effect of MBCT on cognitive emotion regulation, perseverative thinking, and blood sugar in patients with T2DM

Dependent variables	Source of effect	Degree of freedom	Mean squares	F statistic	*P*-value	Eta squared	Power of the test
Cognitive emotion regulation	Group	2	285.831	9.72	0.0001	0.521	0.97
	Pretest	1	3648.465	2483.114	0.21	0.984	1
	Error	41	602.398	-	-	-	-
Perseverative thinking	Group	2	61.345	13.745	0.0001	0.481	0.997
	Pretest	1	4152.209	930.321	0.063	0.958	1
	Error	41	4.463	-	-	-	-
Blood sugar	Group	2	275.973	3.679	0.034	0.345	0.644
	Pretest	1	38548.335	513.956	0.051	0.926	1
	Error	41	75.003	-	-	-	-

processing the systems more effectively (38). In addition, mindfulness helps people with diabetes to pay attention to what exists without changing or avoiding it (42).

Among the findings of the study was the effectiveness of MBCT on perseverative thinking of patients with type 2 diabetes in the pretest phase. These results were in line with the results of some studies (43-46).

Perseverative thinking refers to the negative, situational, and unwanted self-contained thoughts that come to mind when experiencing emotional distress such as illness. These intrusive thoughts are categorized by specific cognitive biases or distortions such as prediction, catastrophizing, labeling, ignoring positive aspects, extreme generalization, blaming, and ignoring contradictory evidence, etc. Cognitive biases make people vulnerable to adverse events such as illness. They are likely to cause negative personalty, and exaggerated interpretations of these problems (47). MBCT focuses on changing the relationship between individuals and their thoughts rather than explicitly targeting the content of thoughts (48). The purpose of mindfulness is to accept the situation as it is. In MBCT, it is possible for individuals to communicate differently with their unpleasant thoughts and emotions and to accept and observe their condition rather than cognitive biases and distortions. MBCT operates through teaching decentralization through thoughts as fleeting and temporary phenomena, not as certain facts but as part of the self and a reflection of reality. If one believes that he/she understands thoughts as certain truths, they can have more adaptive power (49). Mindfulness emphasizing observation and monitoring skills can increase patients' willingness to tolerate a range of internal experiences, even unpleasant ones (50). The cognitive-based mindfulness training program includes training on cognitive aspects, which discusses the relationship between thoughts and feelings, and teaches strategies to decentralize personal thoughts (51). Therefore, teaching mindfulness affects the cognitive system and information processing by increasing the awareness of the present, through techniques such as attention to the body and breathing and shifting the awareness to the present, thereby reducing negative self-thoughts (perseverative thinking).

In addition, MBCT has led to blood sugar control in patients with diabetes in the pretest phase. These findings were in line with the results of some studies (29,52-54).

In explaining this finding, the hormones that determine blood sugar levels are the same as those secreted in stressful situations. Thus, during the anxiety process, hormones affect blood sugar levels and can either increase or decrease insulin production in the body or alter the chemical transfer of insulin in the body (55). MBCT increases the coping skills of diabetic patients against stress and thus reduces stress in them. Stress reduction is ultimately mediated by the hypothalamic-pituitary-adrenocortical system (HPAC), which reduces the secretion of corticoid hormones, particularly cortisol, from the adrenal gland. Since cortisol affects the liver, it increases blood sugar production and reduces its consumption in various tissues of the body (56). It seems that depletion of cortisol has an effect on the liver and therefore increases blood sugar production and reduces its consumption in various tissues. Therefore, depletion of cortisol following training improves blood sugar control and, on the other hand, research shows that when exposed to persistent and severe stressors, diabetic patients are less likely to adhere to treatment and dietary plans and display fewer self-care behaviors. Therefore, reducing stress in diabetic patients both directly and indirectly may affect the control of blood sugar levels.

Conclusions

The present study indicated that MBCT is effective in cognitive emotion regulation, perseverative thinking, and glycemic index in patients with type 2 diabetes. Psychology experts can solve many of these patients'

emotional and cognitive problems by teaching mindfulness techniques and increase their ability to adapt to the disease.

The present study had some limitations and shortcomings that should be taken with caution when generalizing the results. Given the lack of control over influential and disturbing variables such as economic and social conditions, having elderly patients in the study, and conducting the study only on men and women with T2DM in Yazd, findings should be generalized with caution taking into account cultural differences. It is recommended to conduct this study in other cities and on other types of diabetes. Non-pharmacological interventions such as MBCT can be used along with complementary therapies used to treat patients with T2DM in the public and private diabetes centers.

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Conflict of Interest

The authors state that there is no conflict of interest in the present study.

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