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Comparison of the Effectiveness of Metacognitive Therapy and Behavioral Activation on Executive Functions of Elderly People with Type 2 Diabetes

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Abstract

Background: Diabetes mellitus is a metabolic disorder in the body with a constant increasing prevalence.

Objectives: This study aimed to compare the effectiveness of metacognitive therapy and behavioral activation on executive functions of elderly people with type 2 diabetes.

Methods: This quasi-experimental study was conducted based on a pretest-posttest control group design and a three-month follow-up. The statistical population included patients with type 2 diabetes referred to five endocrine clinics located in district 11 of Tehran, Iran, with the age range of 60-75. The samples (n=45) were selected using purposeful and voluntary sampling methods. Wisconsin card was used for data collection. The gathered data were analyzed in SPSS software (version 25) using descriptive statistics, such as mean and standard deviation, and inferential statistics using analysis of covariance and repeated measure ANOVA.

Results: The results showed that there was no statistically significant difference between metacognitive and behavioral activation groups in the subscales of executive function, and the mean posttest of the groups was almost equal ($P<0.05$). Correct reaction time, first patterns attempt were significantly different, compared to the control group ($P>0.05$).

Conclusion: It can be concluded that meta-cognitive therapy and behavioral activation therapy increased effective executive functions.

Keywords: Aged, Executive function, Diabetes mellitus, Metacognition

1. Introduction

The twentieth century is the century of the replacement of non-communicable diseases with the communicable ones in the world and is referred to as an epidemiological revolution. In this century, non-communicable diseases responsible for a significant proportion of deaths globally. According to the results provided by World Health Organization (2015), more than 3 million deaths occurred worldwide due to non-communicable diseases, which accounted for 71.3% of the total number of deaths around the world (1). The combination of depression with diabetes aggravates the course and prognosis of the disease and leads to undesirable consequences. One of these consequences is lowering the level of executive functions.

The results of various studies have confirmed the effect of depression on reducing executive functions (2). Executive functions are important structures that are related to psychological processes responsible for controlling consciousness, thinking, and action. Executive functions are excellent cognitive and metacognitive functions that perform a set of excellent abilities, including self-regulation, inhibition, strategic planning, cognitive flexibility, and impulse control (3). The most important executive functions include organization, decision-making, working memory, motor control, feeling and perception of time, prediction, and problem-solving (4).

The findings of magnetic resonance imaging in studies have shown that different points in the brain structure of depressed patients have different volumes from non-depressed patients. The smaller volumes of the hippocampus in patients with severe depression confirm this hypothesis. The hippocampus is involved in delayed recall tasks. Furthermore, damage to the hippocampus increases apparent memory defects (6).

As the role of psychological interventions in diabetes has increased in recent years, new approaches to the psychological control of this disease have been considered, one of which is metacognitive therapy (7). This approach is an information processing model of the etiology and sustainability of mental disorders, which is based on the fundamental theory of self-regulating executive function. It was firstly introduced by Wells and Mathews in 1994, which was later expanded (8). Metacognition refers to knowledge about thinking, cognition, and factors that influence thought. The metacognition theory and therapy

emphasizes negative beliefs and thoughts as a result of metacognitive control of cognition and states how metacognition is effective in sustaining and changing cognition (9, 10).

In the last decade, the third wave of cognitive therapies has emerged as behavioral activation therapy based on cognition (11). This therapy mainly relies on behavioral activation in the treatment of depression. Although the basis of some aspects of behavioral activation therapy, such as cognitive-behavioral therapy, is to modify the content of thought and cognitive processes, more focus of behavioral activation therapy is on skill training and assignments that ultimately lead to a change in the patient's lifestyle (12). According to the behavioral activation theory, the symptoms of depression and anxiety through avoidant behaviors are effectively short-term emotion regulation strategies; however, over the long term, they create positive environmental consequences in personal life, such as experiencing pleasant activities or creating a sense of mastery (13). This approach, due to its objective techniques and easy implementation, has been tested in mental health centers (14), inpatient centers (15), addiction treatment centers (16), outpatient centers (17), and student counseling centers (18) in groups or individually (19). The results of numerous studies have confirmed the efficacy of this treatment in depression (20-21).

Although various psychological interventions have been administered on type 2 diabetes, to the best of our knowledge, no intervention has been studied so far to compare third wave treatments, including metacognitive therapy and behavioral activation, on depression among patients with type 2 diabetes. Therefore, this study aimed to compare the effectiveness of metacognitive therapy and behavioral activation on depression among elderly with type 2 diabetes.

2. Methods

This quasi-experimental study was conducted based on a pretest-posttest control group design and a three-month follow-up. The study population consisted of the elderly with type 2 diabetes referring to five endocrine and metabolism clinics in district 11 of Tehran, Iran, in 2017. The sample group consisted of 45 men and women, out of which 30 cases were randomly assigned to two case groups (i.e., metacognitive therapy and behavioral activation) and 15 patients in the control group. In this study, metacognitive intervention and activation therapy are considered as independent variables, while, depression is a dependent variable. The control variables were education (higher than diploma) and age (60-75) years. The selection of the samples initiated with making a call in five endocrinology and metabolism clinics in district 11 of Tehran, and then assessing participants based on the inclusion and exclusion criteria. The participants were obtained informed consent and informed about the confidentiality of their information. The sample group was selected from patients with type 2 diabetes referred to the clinic based on inclusion and exclusion criteria and using purposeful and voluntary sampling methods. The cases were subjected to the intervention based on the therapeutic protocol of each intervention (confirmed by10 expert psychologists). The present study was derived from a doctoral thesis in Educational Psychology submitted to the Islamic Azad University of Semnan, Semnan, Iran (IR.IAU.SEMNAN.REC.1398.009).

The inclusion criteria for this study were having type 2 diabetes mellitus diagnosed according to clinical criteria (specialist physician diagnosis and metformin and glibenclamide tablets) and para-clinical (FBS>126, HbA1C>7.0 blood glucose test results), aging 60-75 years old, having education higher than a diploma, and suffering from the illness for more than a year.

Wisconsin Card Sorting Test: This test is one of the main indicators for determining the function of the frontal part of the brain and is the most common test adopted for evaluating executive functions. This test was traditionally used to investigate the executive functions of the brain, including flexibility, problem-solving, and concept formation, and the ability to overcome the tendency to repeat and re-in place. The test has 63 non-similar cards, on each, four types of shapes (i.e., triangles, stars, crosses, and circles) are printed, and the number of each shape on the card fluctuates from one to four. Each card is one of the four colors (i.e., blue, red, yellow, and green). Therefore, the test has four types, four modes, and four colors (three principles). The combination of these three principles makes 63 modes. Each card represents a state that cannot be repeated. The following scores are obtained from this test: 1) The number of correct answers; 2) Error score in the place of staying. This error can be seen when the respondent continues to categorize the cards despite changing the original form of the tester based on the previous principle or the basis of a false suspicion and insists on the wrong answer despite receiving false feedback; and 3) Number of classes. The number of correct categories is defined based on three principles of color, shape, and number and ranges from 0-3. The validity of this test for measuring cognitive failures was estimated more than 0.86 in a study performed by Lezak, and its reliability was obtained at 0.83 based on evaluators' agreement coefficient. The reliability of the Persian version of this test has been reported to be 0.85 using the test-retest method.

The intervention was based on the Wells Protocol (27) (approved by 10 psychologists) and conducted by the researcher for eight 90-minute sessions weekly (Table 1).

In this study, a behavioral activation training package was implemented based on the treatment model of Lejuez et al. (28) (which was approved by 10 psychologists) and conducted by the researcher in eight 90-minute sessions once a week (Table 2).

The collected data were analyzed in SPSS software (version 25) using descriptive statistics, such as mean and standard deviation, and inferential statistics using analysis of covariance and repeated measure ANOVA.

3. Results

According to the results, 7 (47%) and 8 (53%) of the cases in the metacognitive therapy group (n=15) were male and female, respectively. In addition, 6 (40%) and 9 (60%) of the subjects were respectively male and female among the cases in the behavioral activation group (n=15). In the control group, 8 (53%) and 7 (47%) of the

Table 1. Metacognitive therapy session protocol

Session	Content
1	Welcoming and acquainting members with each other by introducing themselves; clarifying therapeutic goals and group rules, including privacy; identifying and naming rumination; practicing attention training techniques; completing the summary sheet of attention training technique; assigning homework: practicing daily attention training techniques (twice a day).
2	Homework checking, depression scale based on the scale of rumination; introducing and practicing broken mindfulness; practicing postponing rumination; presenting the lessons learned daily.
3	Reviewing and executing prior session assignments; identifying motivators and applying broken mindfulness; challenging training with metacognitions on uncontrollability, a survey of activity level, and avoidance coping.
4	Reviewing and executing prior session assignments; checking for postponement of rumination; challenging positive beliefs about rumination.
5	Reviewing and executing prior session assignments; examine the widespread and sustained use of broken mindfulness; examining the level of activity and provide recommendations for improvement (review and prohibition of other maladaptive coping strategies, such as over-sleeping or binge eating).
6	Reviewing and executing prior session assignments; investigating and challenging negative beliefs about sadness/depression; practicing attention training techniques (increasing difficulty level).
7	Reviewing and executing prior session assignments; working on developing new programs (completing the program summary sheet and submitting a copy to the authorities); investigating the fear of returning symptoms.
8	Reviewing and executing prior session assignments; assessing homework and depression scale; preventing recurrence (complete treatment plan); working on residual metacognitive beliefs; forecasting future motivators and discussing how to use the new program; concluding; offering suggestions, and receiving feedback from group members, posttesting implementation.

Table 2. Protocol of behavioral activation therapy sessions

Session	Content
1	Getting to know the members in the group and communicating between groups, introducing group rules (e.g., privacy and regular attendance); presenting the textural pattern of depression; introducing behavioral activation model and treatment; and providing a rationale for treatment.
2	Providing textural patterns of depression and behavioral activation; assigning homework: completing the daily activity registration form.
3	Reviewing previous session exercises; training of Rapa and rapam style skills (i.e., functional analysis and breaking repetitive depression patterns); assigning homework: using distinctive style, and Rapa, and rapam skills.
4	Reviewing the previous session; facing unpleasant situations and reinforcing efficient coping strategies; assigning homework: completing the fun/achievement scale sheet.
5	Reviewing and executing prior session; explaining personal stressors and how depression plays a role in them; discussing the coping avoidance strategies of individuals in coping with stress; investigating and prohibiting maladaptive coping strategies, such as over-sleeping and smoking; assigning homework: examining stressors at different times and performing coping strategies.
6	Reviewing the previous session; training new self-care skills to deal with depression; assigning homework: stressful record situations during the week and how to apply self-care skills.
7	Reviewing the previous session; discussing the importance of social support in dealing with depression; assertiveness training to increase demand or saying no.
8	Reviewing previous sessions; improving communication skills (including empathy, active listening); maintaining self-esteem; preventing recurrence of unhealthy beliefs; reviewing techniques and exercises presented during the sessions and conclusions; offering suggestions; receiving feedback from group members; and posttesting implementation.

participants were male and female, respectively. It was revealed that the highest mean level of education was related to undergraduate (63%), and the highest age group was in 66-70 (47%).

Wilk's lambda multivariate test is used to examine the effect of time on the mean, and the significance of this test indicated that the mean scores varied significantly over time. The results showed that Wilk's lambda was significant for the two groups of metacognitive therapy and behavioral activation, meaning that the mean of executive function was significantly different at different stages of pretest, posttest, and follow-up (P<0.05). In the control group, the Lambda-Wilkes test was not significant, meaning that the mean depression in the three stages of pretest, posttest, and follow-up did not change significantly in the control group and was approximately equal.

Wilk's lambda = 0.277, F = 6.12, P < 0.001

The results of Table 4 show that the intervention has a significant effect on four subscales of Wisconsin (P<0.01). The significance levels obtained for the following 5 subscales were less than the assumed value of 0.05, indicating that the intervention was effective on the subscales of the number of completed classes and the number of correct answers. The results showed that the intervention had no effect on other scales, and the significance level for the following subscales was more than (P<0.05). The least significant difference posttest was used to compare the posttest scores after controlling the pretest scores (Table 5).

The results of Table 5 show that there is no statistically significant difference between metacognitive and behavioral activation groups in the subscales of executive function, and the mean posttest of the groups was almost equal (P<0.05). Correct reaction time, first patterns attempt were significantly different, compared to the control group (P>0.05).

Table 3. Descriptive statistics of the mean and standard deviation of executive function scores by group type and test stage

Variables	Group	Pretest	Posttest	Follow-up
Numcatcom	Metacognition	1.93	2.41	2.44
	Behavioral activation	2.00	2.59	2.55
	Control	1.87	1.93	1.94
Pererr	Metacognition	16.60	11.84	11.93
	Behavioral activation	15.47	11.21	11.33
	Control	16.40	16.01	16.68
Tonumcor	Metacognition	27.93	35.60	36.53
	Behavioral activation	28.00	34.87	34.53
	Control	28.20	30.47	30.87
Tonumerr	Metacognition	32.07	31.40	31.53
	Behavioral activation	32.07	31.24	31.07
	Control	32.73	31.93	32.80
Nonerr	Metacognition	20.13	19.13	20.40
	Behavioral activation	20.67	18.13	18.73
	Control	19.93	20.00	20.33
Timetest	Metacognition	424.33	306.73	316.00
	Behavioral activation	424.33	324.60	321.00
	Control	428.20	404.93	404.27
Trylevone	Metacognition	16.53	25.25	26.67
	Behavioral activation	16.73	23.93	22.47
	Control	16.53	16.13	18.07
Perconres	Metacognition	1.60	2.27	2.40
	Behavioral activation	1.73	2.53	5.73
	Control	1.67	1.80	1.80
Failmain	Metacognition	0.20	0.33	0.40
	Behavioral activation	0.20	0.40	0.33
	Control	0.33	0.33	0.47
Percentcon	Metacognition	26.93	27.73	26.53
	Behavioral activation	24.20	26.13	26.53
	Control	23.20	23.20	27.40

Table 4. Test results (Mancova) to investigate the effect of the intervention on Wisconsin test subscales

Source	Variables	MS	Df	F	P-value	Eta
Group	Numcatcom	7.54	2	3.77	0.016	0.11
	Pererr	210.95	2	9.61	0.001	0.20
	Tonumcor	1,062.61	2	12.82	0.001	0.25
	Tonumerr	71.99	2	3.11	0.052	0.08
	Nonerr	62.65	2	2.93	0.059	0.07
	Timetest	37,769.10	2	8.67	0.001	0.18
	Trylevone	259.11	2	7.19	0.001	0.16
	Perconres	12.32	2	2.19	0.108	0.05
	Failmain	0.47	2	2.41	0.097	0.06
	Percentcon	88.85	2	0.55	0.582	0.01

Table 5. Posttest result for comparing posttest scores between groups

Variables	(I-J)	Mean difference	Standard error	P-value
Numcatcom	Metacognition-behavioral activation	-0.18	0.19	0.14
	Metacognition-control	0.48	0.17	0.012
	Behavioral activation-control	0.66	0.16	0.005
Pererr	Metacognition-behavioral activation	0.63	0.45	0.154
	Metacognition-control	-4.17	1.24	0.012
	Behavioral activation-control	3.07	1.11	0.008
Tonumcor	Metacognition-behavioral activation	0.73	0.62	0.067
	Metacognition-control	5.87	1.39	0.001
	Behavioral activation-control	4.40	1.23	0.001
Tonumerr	Metacognition-behavioral activation	0.16	2.03	0.607
	Metacognition-control	-0.53	2.08	0.227
	Behavioral activation-control	-0.69	2.10	0.095
None	Metacognition-behavioral activation	0.88	1.34	0.515
	Metacognition-control	-1.27	1.37	0.358
	Behavioral activation-control	-2.15	1.38	0.129
Timetest	Metacognition-behavioral activation	-17.87	9.42	0.068
	Metacognition-control	-98.20	14.03	0.001
	Behavioral activation-control	-80.33	16.89	0.001
Trylevone	Metacognition-behavioral activation	1.32	0.98	0.195
	Metacognition-control	8.72	1.63	0.001
	Behavioral activation-control	7.40	1.80	0.001
Perconres	Metacognition-behavioral activation	-0.13	0.50	0.792
	Metacognition-control	0.76	0.51	0.144
	Behavioral activation-control	0.89	0.51	0.092
Failmain	Metacognition-behavioral activation	-0.08	0.13	0.545
	Metacognition-control	0.11	0.13	0.413
	Behavioral activation-control	0.19	0.13	0.168
Percentcon	Metacognition-behavioral activation	0.19	3.69	0.959
	Metacognition-control	2.32	3.78	0.543
	Behavioral activation-control	2.13	3.82	0.581

4. Discussion

This study was conducted to compare the effectiveness of metacognitive therapy and behavioral activation on depression in the elderly with type 2 diabetes. The results of this study showed that metacognitive therapy was effective in increasing cognitive flexibility and attention in executive functions of elderly people with type 2 diabetes. The findings of this study are in line with those of the following researches. The results of a study conducted by Groves et al. showed that metacognitive therapy was

more effective than cognitive-behavioral therapy and would improve cognitive functions, cognitive flexibility, and attention.

In research carried out by Nordahl and Wells (22), it was concluded that negative metacognitive beliefs were effective in reducing executive functions. The findings of a study conducted by Normann and Morina (23) showed that metacognitive therapy with an emphasis on executive functions reduced cognitive-attention syndrome and improved an individual's sense of coherence. Strand et al. (24) concluded that metacognitive therapy intervention, causing working memory function and verbal memory, could be used to improve these variables in people with post-traumatic stress disorder.

In explaining the findings of this study, it can be said that the results of pieces of research performed on the role of the fore stratum in human behavior showed that this part acts as a center for controlling human behavior. The executive functions are attributed to the control and command functions of the forehead, which play a role in adaptive behaviors, social behavior, flexibility, thought and actions, and goal achievement (25). Attention control is an important factor in emotional disorders. Adaptive coping with the problem is (26). The technique of attention training in metacognitive therapy is accomplished through 1) weakening self-focused attention, 2) eliminating processing rumination based on worry, 3) increasing control over attention, and 4) strengthening the metacognitive model of information processing with reduction of the cognitive-attention syndrome (27). Metacognition has decreased. Metacognitive therapy also supports the processes of creating and correcting self-thought. Therefore, the techniques of this treatment cause the person to observe his/her actions as an external observer. The technique of faulty mindfulness increases consciousness of the consciousness itself, which itself reaches the inner consciousness that causes cognitive flexibility (29).

Given the prevalence of diabetes and its complications, it is suggested that more psychological interventions be performed, in addition to the administration of drug interventions. Most of these interventions can be attributed to metacognitive and behavioral activation interventions due to exercises and applied skills. It is suggested that these interventions be applied to other psychological complications of diabetes, as well as to other chronic diseases.

5. Conclusion

It can be concluded that the use of metacognitive therapy and behavioral activation interventions can be used as effective therapies in type 2 diabetic patients with symptoms of depression.

Ethical Considerations

Compliance with ethical guidelines

All ethical principles were considered in this article. The participants were informed about the purpose of the research and its implementation stages and they signed the informed consent. They were also assured about the confidentiality of their information. Moreover, they were informed about the possibility of study withdrawal at any research stage and the availability of research results at their request. This article was derived from the student's doctoral dissertation of Psychology submitted to the Islamic Azad University of Semnan. This study is approved by the Ethics Committee of the Islamic Azad University of Semnan (IR.IAU.SEMNAN.REC.1398.009).

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Conflicts of interest

The authors declare that there is no conflict of interest.

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