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Research Article

The Comparison of the Effectiveness of Acceptance and Commitment Therapy and Health-promoting Lifestyle Intervention in the Management of Glycated Hemoglobin Levels in Type 2 Diabetes

Nasim Soltanian[1], Isaac Rahimian Boogar[2] , Siavash Talepasand [3]

1. Ph.D. Student of Psychology, Department of Clinical Psychology, Faculty of Psychology and Educational Sciences, Semnan University, Semnan, Iran.
2. Associate Professor, Department of Clinical Psychology, Faculty of Psychology and Educational Sciences, Semnan University, Semnan, Iran.
3. Associate Professor, Department of Educational Psychology, Faculty of Psychology and Educational Sciences, Semnan University, Semnan, Iran.

Article Info

Corresponding Author:
Isaac Rahimian Boogar

Email:
i_rahimian@semnan.ac.ir

Abstract

Aim: Non-pharmacological treatment models are offered to the diabetics to better manage their diabetes and blood sugar. This study compared two popular treatments which are evidenced to have an acceptable effect on diabetes. The purpose of this study was to compare the effectiveness of acceptance and commitment therapy (ACT) and health-promoting lifestyle intervention or diabetes self-management program (DSMP) in the management of HbA1c.

Methods: A total of 60 patients referred to Tehran Diabetes Treatment centers were selected by convenience sampling and were assigned to three 20-member groups. The first group received ACT intervention, the second group received DSMP intervention, and the third group did not receive any intervention. All the three groups received relevant medications during the study. They were examined for glycated hemoglobin in the three phases of before the intervention, after the intervention and follow-up using blood tests. The data were analyzed using descriptive statistics and mixed-design analysis of variance

Results:. The results showed that both ACT and DSMP methods were effective in improving the Management of Glycated Hemoglobin Levels in Type 2 Diabetes (F=5.835, P value<0.005). In addition, the effectiveness was sustained until the follow-up phase (F=26.274, P value<0.001). However, the comparison of the two treatments showed that ACT was more effective than DSMP in post-test and follow-up phases (F=10.902, P value<0.001).

Conclusion:. It seems that along with pharmacological treatments, ACT could be significantly effective in the management of glycated hemoglobin levels. Glycated hemoglobin levels were better managed with the lifestyle modification by ACT than DSMP

1. Background

Diabetes mellitus, simply called diabetes, is a serious, chronic condition which occurs when a person's blood glucose level rises (Goyal & Jialal, 2023). Diabetes describes a group of specific metabolic disorders and is diagnosed by the occurrence and recurrence of hyperglycemia in the absence of treatment. Type 2 diabetes is the most common type of diabetes which affects about 90% of the diabetics (American Diabetes Association, ADA, 2020). Heterogeneous causes of diabetes include insulin secretion, insulin dysfunction, or both, carbohydrate disorder, obesity or abnormalities in protein metabolism (ADA, 2020). Diabetes may also be associated with certain symptoms such as thirst, frequent urination, blurred vision, and weight loss. It may even lead to death if left untreated. The specific and long-term effects of diabetes include retinopathy, neuropathy, and nephropathy. Patients are also at risk of other brain and cardiovascular diseases, obesity, cataracts, sexual problems, fatty liver and some infectious diseases such as tuberculosis (ADA, 2020).

The prevalence of type 2 diabetes is increasing and this is one of the leading factors of death in the world (Page-Reeves et al., 2023). The worldwide prevalence of diabetes in 2019 was estimated to be 463 million people. It is estimated that without effective intervention in 2030, about 578 million people and in 2045, about 700 million people would affected by diabetes (Goyal & Jialal, 2023). Diabetes and its complications, in addition to the financial and economic burden, puts a lot of pressure on the family and the health-care systems (Adu et al., 2019). Diabetes is one of the most common problems in Iran, and every year a huge amount of money is spent on drug treatments (Nasri & Nasri, 2017, Rahimian Boogar et al., 2013). The prevalence of diabetes in Iran was reported at 12.2% in 2019, which is expected increase to 13.3% in 2030 and reach to 13.9% in 2045 (Khodakarami et al., 2022).

Nowadays, various associations and centers offer some protocols for diabetes self-management. Thus, to ensure the effectiveness of such programs, in a meta-analysis, researchers found that lifestyle interventions, including dietary changes, exercise, and related training, significantly reduced the symptoms of cardiovascular problems such as body mass index, glycated hemoglobin, systolic and diastolic blood pressure, LDL (low-density lipoprotein) cholesterol and triglycerides (Shiferaw et al., 2021). However, despite the effectiveness of healthy lifestyle in the recovery and self-care process, patients do not maintain a healthy lifestyle because it seems that living with this new lifestyle is not feasible in the long run, and patients would get tired (Gregg et al., 2007a). Continuous medical visits, special diets, unfair comparisons, and concern about the complications of diabetes are main chalenges which accompanied with elevated stress in patients with diabetes (Cardel et al., 2020; Gregg et al., 2007a). In addition to drug treatment, various psychological interventions and trainings for diabetics have been designed, developed and adminestrated (Upsher et al., 2021; Champen et al., 2015). The main objective of such interventions for diabetic patients is improvement in their self-management ability to cope with diabetes (Mustapa et al., 2022). The ultimate goal of designing and presenting such interventions is to control the blood glucose level, which is considered as the most reliable metabolic indicator of diabetes (Shiferaw et al., 2021). On the other hand, diabetic patients need to manage and monitor their disease via major dietary changes, blood glucose tests and

injections, and common medical records which are performed not only by medical care providers but also monitored daily at home by the patients themselves (Gregg et al., 2007a).

Thus, treatment protocols with more psychological load have been designed for better copying with diabetes (Shayeghian et al., 2016). Health-promoting lifestyle which is a diabetes self-management program (DSMP) is more systematic and comprehensive, and pays more attention to psychological issues than similar intervention. DSMP is comprehensive and standard health-promoting lifestyle intervention which meets the standards of American Diabetes Association, contains psychological program and is based on the Stanford Medical University model (Gregg et al.,2007b; Page-Reeves et al., 2023). The DSMP had a 76% reduction in the risk of physical problems, a 50% reduction in the risk of kidney diseases, and a 60% reduction in neurological diseases (Gregg et al.,2007b).

Furthermore, ACT as the main focus in the present study is relatively new type of treatment, cost-effective in terms of time and cost and comprehensive and contextual approach to life and its challenges (Hayes et al., 2013). ACT is an interventional approach designed to control, manage, and make an effective use of language. The objective of ACT is to help patients to achieve appropriate levels of psychological flexibility (Hayes et al., 2013; Hayes, 2019). It also emphasizes accepting negative thoughts and feelings and adverse life events. This is important since diabetic patients often do not cope with their thoughts and feelings about diabetes (van der Feltz-Cornelis et al., 2021). Factors such as acceptance, commitment and movement according to values are among the areas which distinguish the ACT from other psychological approaches. Thus, it can provide the patients with significant assistance (Hayes et al., 2013). Meta-analysis studies which briefly examined the effectiveness of ACT concluded that this intervention is likely to be effective for a wide range of psycho-social aspects of diabetes (Maghsoudi et al, 2019; Sakamoto et al, 2022). Moreover, in-depth study is required in this field. However, considering of comparisons between effective treatment models is important to design the more cost-effective combined models for management of diabetes in the future. In this study, acceptance and commitment therapy (ACT) is compared with diabetes self-management program (DSMP) in the management of Glycated Hemoglobin Levels in type 2 diabetes. Therefore, facilitating the selection of a more effective approach in the variety of complementary therapies and lifestyle-based interventions can help therapists and patients to choose a more effective treatment. This study is one of the first attempt to compare two psychological interventions for diabetic patients in Iran. It can help health-care providers and patients to select the most effective and sustainable interventions in the future.

2. Objectives
The aim of this study was to compare the effectiveness of acceptance and commitment therapy and health-promoting lifestyle intervention in the management of glycated hemoglobin levels in type 2 diabetes.

3. Methods
3.1. Sample and procedure
This is quasi-experimental study with the treatment-control pre-post-follow-up (TCPPF) design. The statistical population included the diabetic patients. Among the patients who

referred to Tehran Diabetes Treatment centers in 2019-2020, 60 participants were selected through convenience sampling method. The sample size was determined through G*Power software with considering the expected effect size (0.25), alpha value (0.05), z value (1.96), test power (0.80), the number of within-group effect levels (3) and the number of between-group effect levels (3). The participants were randomly assigned to three groups. In fact, 20 participants were randomly assigned to the ACT group, 20 participants were randomly assigned to the health-promoting lifestyle intervention group (DSMP), and 20 participants were randomly assigned to the control group. The sample was homogeneously selected concerning the time they got diabetes. The inclusion criteria included diagnosis with type 2 diabetes by physician, age range of 35 to 60 years, having passed at least one year from diabetes, having a minimum literacy. The exclusion criteria included having other types of diabetes, having mental disorders and other severe medical diseases, having more than 10 years of the history of type 2 diabetes and hospitalization and unwillingness to continue participating in the study. In order to control the confounding effects caused by similar psychological interventions, people who have not used psychological services in the past year were selected to participate in the study. The inclusion/exclusion criteria were checked through an initial semi-structured interview.

Prior to the interventions, glycated hemoglobin levels in all the three groups were measured by a blood test in the laboratory. Three months after the interventions (posttest phase) and six months after the interventions (i.e., follow-up phase), blood tests were performed. Health-promoting lifestyle intervention diabetics were based on the DSMP approach, and consisted of six two-hour sessions during six weeks. The control group did not receive any intervention and it was examined only at the beginning and at the end of the study, and in the follow-up phase. At the end of the study, the interested participants in the control group were provided with more effective training for ethical considerations.

3.1.1. Acceptance and Commitment Therapy (ACT) for diabetic patients
In this study, ACT is formulated for self-management of diabetic patients according to the protocol of Greg et al. (Gregg et al., 2007a, 2007b). Acceptance and Commitment Therapy (ACT) consisted of eight two-and-a-half-hour sessions during eight weeks. Therapeutic sessions in this study were set up, tailored and implemented based on the theoretical foundations.

3.1.2. Lifestyle-promoting intervention/diabetes self-management program (DSMP) for the diabetics
This program is a structured training program based on active learning developed by Gregg et al (2007b) based on the Diabetes Control and Complicatios Trial (DDCT). The DSMP considers behavioral changes and motivational supports and it is implemented in six weeks. In this study, according to DDCT (Gregg et al.,2007b), the lifestyle-promoting intervention administrated for the diabetics. The treatment protocols based on ACT and lifestyle-promoting intervention were presented in table 1.

3.2. Research Tools
Glycated hemoglobin (HbA1c) test
Glycated hemoglobin (HbA1c) test measures glycated hemoglobin level in patients with

diabetes and is clinically very important. The HbA1c reflects the mean blood sugar over the past three months, and provides a useful tool for monitoring glucose status in the long run (ADA.2020; Valenzano et al., 2023). In this study, patients with type 2 diabetes were tested for glycosylated hemoglobin before and after the interventions, and in the follow-up phase.

Table 1. The ACT protocol and lifestyle-promoting intervention protocol

	ACT Protocol Contents
1	Introducing a psychological flexibility, creating a treatment alliance, information providing about diabetes self-management
2	Information providing about diabetes complications. self-care and medicines in diabetes, exercise and diabetes, taking care of organs such as eyes and feet
3	Identifying values, living in the path of values, and the role of values in diabetes control
4	Selecting and information providing about the experimental avoidance in a theoretical and practical way, examining the experimental avoidance in diabetes
5	Accepting the disease and committing to adjustment with diabetes and performing self-care activities in order to enjoy a rich and complete life
6	Mindfulness and living in the present moment, the role of mindfulness in coping with tensions and distress and in the diabetes management
7	Explaining the concepts of self-as-context and self-as-process and the role of this methods in physical and mental health
8	Summarization, reviewing the topics and answering questions and solving problems

	Lifestyle-promoting intervention/DSMP Protocol
1	Familiarization with the goals and framework of the training course and stating the role and importance of self-management in improving the quality of life of diabetic patients
2	Explaining the antecedents of diabetes, medical issues, drug therapy and disease complications, the results of lack of control and its control methods and goal setting methods, blood sugar monitoring
3	Recounting the importance of self-care behaviors in improving their lifestyle and medical condition, introducing suitable sports and physical activities and improving their attitude regarding suitable physical activities
4	Explaining the issues related to nutrition, the role of food, and good foods in type 2 diabetes and modification of food patterns
5	Recounting the role of psychological issues and stress control, relaxation techniques and difficult emotions in diabetes and prevention of its complications
6	Summarization and review previously taught cases and answer patients' questions

3.3. Ethical consideration

At first, those who had the inclusion criteria and were interested to participate in the study signed the Informed consent form. Particpants were assured that all their medical information would be considered confidential, and the scientific results of this study would be published in general. This study has been approved by the ethics committee of Semnan University of Medical Science in March 14, 2018 (code: IR.SEMUMS.REC.1396.257) and it has been registered in Iranian Registry of Clinical Trials (IRCT) in May 22, 2018 (Trial registration number of IRCT20180404039185N1).

3.4. Data analysis

In order to analyze the data, a mixed-design analysis of variance with within-group, between-group and interaction effects was used. Before performing multivariate tests, the assumptions of the mixed-design analysis of variance, including unanswered cases, univariate extreme cases (non-existence of Z score above 3.29), normality of the distribution (using Smirnov calmograph test), covariance matrix homogeneity (using Box's test) and error variance homogeneity (using Levene's test) were examined. The results showed that the statistical presuppositions are confirmed and valid and parametric analysis can be used. Data were analyzed by SPSS-22 software.

4. Results

4.1. Demographic Information

The mean and the standard deviation of the age of the ACT intervention group, DSMP intervention group and the control group were 50.35 (4.38), 49.11(4.61), and 50.07 (4.57), respectively. In addition, the mean and the standard deviation of the duration of disease in the ACT intervention group, DSMP intervention group and the control group were 1.42(4.15), 1.45(4.10), and 1.36(4.05), respectively. The means (standard deviations) indicate the homogeneity of the three groups in terms of age and duration of disease. The demographic characteristics (frequency and percentage) of literacy Level and gender are listed in Table 2.

Table 2. Demographics characteristics of the participants

Variables	Steps	ACT n(%)	DSMP n(%)	Control n(%)	Chi²/F	P value
Literacy Level	Below diploma	15(%3)	15(%3)	25(%5)	3.639	0.725
	Diploma	25(%2)	45(%9)	40(%8)		
	Association degree	20(%4)	15(%3)	15(%3)		
	Bachelor	40(%8)	25(%5)	20(%4)		
Gender	Female	25(%5)	25(%5)	25(%5)	0.001	0.999
	Male	75(%15)	75(%15)	75(%15)		

There were no significant differences among the groups in terms of Literacy Level, but there were significant differences among the groups in terms of gender (Table 2).

4.2. Results Tables

Table 3 shows the descriptive statistics of the level of Glycated hemoglobin (HbA1c) test in regard to the assessment phases and groups.

Table 4 shows the main and the interaction effects of intervention on the variables of the study. The within-group effect (F= 26.274, P= 0.001), the between-group effect (F=5.835, P= 0.005) and the interaction effect (F= 10.902, P= 0.001) were significant on the HbA1c level. The intervention led to the reduction of the amount of HbA1c. In

addition, in regard with the within-group effect, the repetition of the measurement shows that this effectiveness was stronger over time (Table 4).

Table 3. Descriptive statistics of the groups in terms of HbA1c and assessment phases

Variable		ACT intervention group		Health-promoting lifestyle intervention group		Control group	
		M.	SD.	M.	SD.	M.	SD.
HbA1c	Pretest	8.28	1.12	8.47	1.25	8.30	1.20
	Posttest	7.22	0.95	7.88	0.99	8.28	1.00
	Follow-up	6.65	0.63	7.72	0.86	8.33	0.87

Table 4. The main and the interaction effects on glycosylated hemoglobin level

		SS	df.	MS	F value	Sig.	Eta
Within-group	Sphericity	17.63	2	8.82	26.274	0.001**	0.327
	Greenhouse-Geisser	17.63	1.57	11.20	26.274	0.001**	0.327
Within-group * Between-group	Sphericity	14.63	4	3.66	10.902	0.001**	0.288
	Greenhouse-Geisser	14.63	3.15	4.65	10.902	0.001**	0.288
Between-group		27.811	2	13.906	5.835	0.005*	0.178

* p≤0.05, ** p≤0.01

Table 5. Paired between-group and within-group comparisons in terms of HbA1c

Effects	Assessment phase	Paired comparisons		Mean difference	Std error	Sig.
Between-groups	Pretest	ACT	Health-promoting lifestyle	-0.19	0.39	0.999
			Control	-0.02	0.39	0.999
		Health-promoting lifestyle	Control	0.01	0.39	0.999
	Posttest	ACT	Health-promoting lifestyle	-0.66	0.31	0.114
			Control	-1.06	0.31	0.003*
		Health-promoting lifestyle	Control	0.04	0.31	0.592
	Follow-up	ACT	Health-promoting lifestyle	-1.07	0.25	0.001**
			Control	-1.68	0.25	0.001**
		Health-promoting lifestyle	Control	-0.61	0.25	0.001**
Within-group	ACT	Pretest	Posttest	1.08	0.09	0.001**
			Follow-up	1.63	0.14	0.001**
		Posttest	Follow-up	0.56	0.11	0.001**
	Health-promoting lifestyle	Pretest	posttest	0.60	0.19	0.021*
			Follow-up	0.74	0.26	0.033*
		Posttest	Follow-up	0.14	0.14	0.983
	Control	Pretest	posttest	-0.049	0.19	0.999
			Follow-up	-0.086	0.26	0.999
		Posttest	Follow-up	-0.037	0.20	0.999

* p≤0.05, ** p≤0.01

The effect size (Eta) indices were 0.327, 0.178, and 0.288 for within-group, between-group, and interaction effects, respectively (Table 4). Paired comparisons in Table 5 show that there was no difference between the three groups in terms of HbA1c level in the pretest phase. However, in the posttest and follow-up phases, the observed difference between the control group and the ACT and health-promoting lifestyle intervention groups was statistically significant (Table 5). Moreover, there was a significant difference between the two intervention methods in terms of the effectiveness in the two variables. The results showed that ACT method led to more changes, and its effect was significant in posttest and follow-up phases. However, health-promoting lifestyle method showed less effectiveness in the follow-up phase. Furthermore, the paired comparisons between the steps showed that there was no difference between the three measurement steps in the control group, but there was a significant difference between different steps of the study in the ACT and the health-promoting lifestyle groups. These findings indicate that the intervention led to a change in HbA1c, and ACT method was the most effective intervention (Table 5).

Moreover, Figure 1 shows the changes in HbA1c level in regard with the type of intervention in each assessment phase.

Figure 1. Glycated hemoglobin level in regard with assessment phases and groups
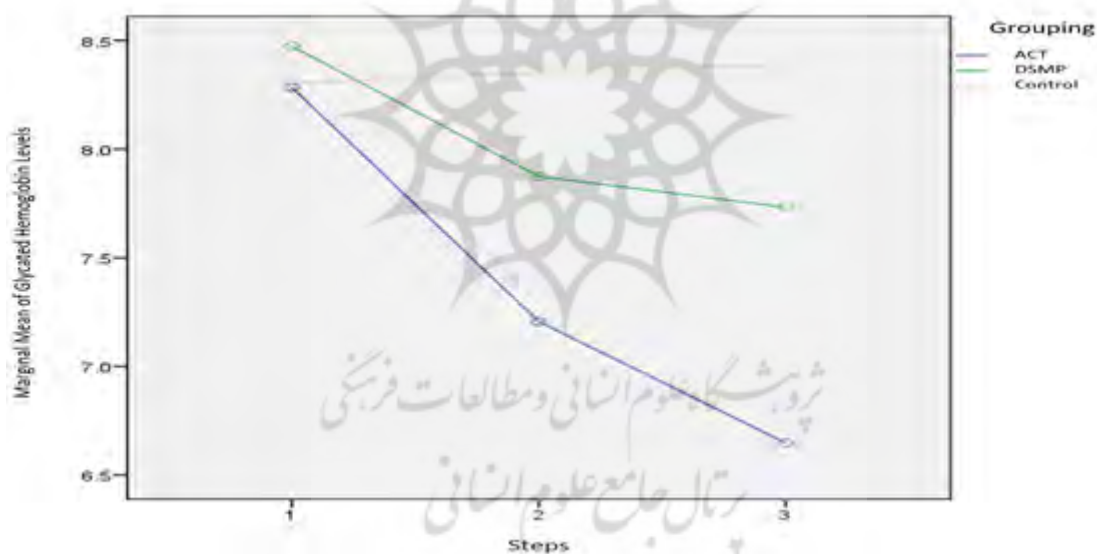
5. Discussion

This study aimed to compare of the effectiveness of acceptance and commitment therapy and health-promoting lifestyle intervention in the management of Glycated Hemoglobin Levels in type 2 diabetes. The results showed that both ACT and DSMP methods were effective in improving the management of Glycated Hemoglobin Levels in type 2 diabetes. As the results showes, ACT led to more effective management of diabetes and reduction of glycated hemoglobin in diabetic patients. This finding is consistent with the studies by Gregg et al. (2007a), Cardel et al. (2020) and Sakamoto et al. (2022) which investigated the effectiveness of ACT in self-care activities and glycated hemoglobin level in the sample of patients with type 2 diabetes. These studies showed the improvement of the patients' self-care behaviors and the reduction of the glycated hemoglobin level. Furthermore, Ataie Moghanloo et al. (2015) found that ACT intervention positively affected self-efficacy

and reduced glycosylated hemoglobin. Moreover, Maghsoudi et al. (2019) showed that ACT reduced emotional distress and improved the quality of life in individuals with Type 2 diabetes. Also, this finding is consistent with study of Ryan et al. (2020) which showed that ACT was a promising method to strengthen resilience and supportive factors in diabetic patients. The main contents of ACT for diabetic patients are control language and thinking, transforming cognitive fusion into cognitive defusion, changing self-as-concept or self-as-content to self-as-context and self-as-process, clarifying values in living with dibetes, strengthening mindfullness, reducing experiencial avoidance. and strengthen the effective actions, So, ACT created a significant improvement in resilience, psychological flexibility, positive emotion and valuable life among patients. It led to the modification of sedentary and behaviors in diabetic patients. It subsequently improved the mental health of the patients. Furthermore, the findings of this study are in line with study of Sakamoto et al. (2022) which indicated that ACT increased self-efficacy in diabetes care and decreased glycated hemoglobin level. Furthermore, these findings are consistent with studies of Shayeghian et al.'s (2016) and Kioskli et al. (2020) which focused on the effectiveness of ACT in the diabetes management and the reduction of glycosylated hemoglobin. In addition, Zandi et al. (2023) argued that ACT had a positive effect on the psychological health and the life satisfaction of type 2 diabetic patients. In follow-up phase, similar to studies by Gregg et al. (2007a) and Shayeghian et al. (2016), the intervention was significant. It can be argued that the long-term effectiveness of the ACT was supported even after six-months following the intervention. In addition, health-promoting lifestyle intervention had an effect on reducing glycosylated hemoglobin level. This finding is consistent with the study of Chawla et al. (2020), Page-Reeves et al., (2023), and González-Rivas et al. (2022) which showed the effect of health-promoting lifestyle on the diabetes self-management. Werfalli et al. (2020) also stated that the health worker-led self-management support programs, which was relatively similar to the DSMP intervention, was effective in health-related, psycho-social and physiological outcomes of adults with type 2 diabetes in low-income communities. Moreover, González-Rivas et al. (2022) emphasis on the effectiveness of exercise and nutrition in the quality of diet and blood glucose. Also, Baroni et al. (2022) and Werfalli et al. (2020) argued that the DSMP interventions via improvement in diabetes self-management and self-care behaviours effects on blood sugar control in type 2 diabetes. In fact, DSMP is the comprehensive treatment included measuring glucose level, using insulin four or more times a day, and following a strict diet and exercise. In addition, patients had monthly appointments with physicians, nursing educators, nutritionists, and behavioral therapists.

However, in contrary to the findings of the present study, in the finding by Werfalli et al. (2020), The intervention lost its effect in the follow-up phase. This discrepancy may be accounted for by referring to the fact that the physician and the nutritionist were experienced and trained in the World Diabetes Association. However, the remarkable point is that ACT was more effective than health-promoting lifestyle intervention with DSMP model, while the control group did not show any significant change. Similarly, in the follow-up phase, the effectiveness of ACT was significantly higher than that of the health-promoting lifestyle intervention; the control group did not show any significant change. The results of this study seem to be consistent with the study by Shayeghian et al. (2016) which showed that acceptance in diabetic patients was significantly associated

with better perception of the disease, increased self-care behaviors and decreased glycosylated hemoglobin level.

Researchers believe that the control of blood glucose cannot be achieved without self-management and self-care behaviors. Gregg et al. (2007a) argued that self-management activities play a significant role in the treatment of diabetes, However, as van der Feltz-Cornelis et al. (2021) argued that disease avoidance is prevalent among patients with diabetes, so that they may not engage in activities related to self-care and self-management behaviors. Hayes et al. (2013) state that empirical avoidance occurs when a person is reluctant to stay in touch with personal events such as psychological and physical pains, thoughts and emotions. In this regard, Kalra et al. (2018) showed that avoiding thoughts and emotions related to diabetes was associated with inadequate blood sugar control. ACT can be a significant sterategy in overcoming empirical avoidance through observation techniques which facilitate accepting the disease, negative thoughts and emotions. Thus, as Hapunda (2022) noted that the development of acceptance would reduce the level of glycosylated hemoglobin.

It seems that understanding the cause of diabetes and being aware of issues and concepts related to the disease lead to a better adjustment with diabetes. According to Hayes (2019), paying attention to psychological issues in the form of the hexagon of flexibility and receiving diabetes instructions can reduce avoidance of negative thoughts and can facilitate acceptance and results in values clarification and monitoring mental and physical needs and conditions. Furthermore, living in the present and paying attention to oneself as a context reinforce persons to perform committed activities in line with his values and goals. Kalra et al. (2018) argued that behaviors such as timely medication, exercise and adherence to diet increase metabolism, and consequently decrease blood sugar. It seems that ACT, which has a systematic structure and would lead to the psychological flexibility, is more effective in the management and the reduction of glycosylated hemoglobin in type 2 diabetes than the lifestyle-promoting approach.

6. Limitation and Recommendation

There were some limitations in conducting this study. Low motivation of the participants was one of the main issues which could effect on results. Commitment of the participants to do the tasks during the intervention was another major challenge. Finding participants who did not use psychiatric drugs and did not receive any intervention was another difficult task; however, it increased the accuracy of the findings. It is suggested that further studies conduct a motivational interview at the beginning to increase the sample' participation. Moreover, in addition to performing blood test, other measures, especially the opinions of the patients' relatives, can be used to assess how well the patients adjust with the disease. More research with a quantitative-qualitative (mixed) approach is necessary to obtain more definitive results in this field in Iran.

7. Conclusion

In this study, it is concluded that although treatment based on commitment and acceptance therapy (ACT) and health-promoting lifestyle intervention are different in effectiveness, both interventions are effective in managing glycated hemoglobin levels in diabetic patients. It seems that, along with pharmacotherpy, the ACT protocol, which is a

combination of medical instructions and nutrition within ACT approach for type 2 diabetic patients, can be more effective. It seems that acceptance, moving towards values, mental resilience, commitment and adherence to the new lifestyle improves the effective behavior, self-care and self-management of patients. Finally, the levels of glycosylated hemoglobin are better managed by accepting, acting effectively and adopting a healthy lifestyle.

8. Author Contributions

Nasim Soltanian was responsible for preparing and conducting the research design, collecting, analyzing, and interpreting the data, writing the first manuscript and confirmed the final article. Dr. Isaac Rahimian Boogar, as corresponding author and the supervisor of the doctoral thesis, supervised the study process and reviewed, revised and confirmed the final article. Dr. Siavash Talepasand has been responsible for providing guidance and pointing out the necessary tips on the statistical topics, study process and confirmed the final article.

9. Ethical moral code

This study has been approved by the ethics committee of Semnan University of Medical Science in March 14, 2018 (code: IR.SEMUMS.REC.1396.257). Also, the study has been registered in Iranian Registry of Clinical Trials (IRCT) in May 22, 2018 (the (Trial registration number: IRCT20180404039185N1)

10. Acknowledgment

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11. Conflicts of interest

This research is not sponsored by any institution and all costs have been borne by the authors. The authors declare there is no conflict of interest in this article.

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