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Comparison of the Effectiveness of Mindfulness-Based Stress Reduction Program and Acceptance and Commitment Therapy on Quality of Life and Glycemic Control Index in Women with Type 2 Diabetes

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ABSTRACT

Type 2 diabetes is one of the most prevalent chronic diseases worldwide that, in addition to its physical consequences, is associated with numerous psychological outcomes, including reduced quality of life and impaired glycemic control, particularly among women. The present study aimed to compare the effectiveness of the Mindfulness-Based Stress Reduction (MBSR) program and Acceptance and Commitment Therapy (ACT) on quality of life and glycemic control indices in women with type 2 diabetes. The study employed a quasi-experimental design with pre-test, post-test, and follow-up phases alongside a control group. The statistical population included all women with type 2 diabetes who attended the Charitable Association for the Support of Diabetic Patients in Tehran, Iran, between September and November 2024. Among them, 45 participants were selected through convenience sampling and randomly assigned to three groups (MBSR, ACT, and control). Participants in the experimental groups received group-based interventions during eight 90-minute sessions. Research instruments included the Diabetes Quality of Life Questionnaire (DQOL) and medical tests for measuring glycated hemoglobin (HbA1c). Data were analyzed using mixed repeated-measures analysis of variance. The results indicated that both interventions significantly improved quality of life and reduced glycated hemoglobin levels; however, the Mindfulness-Based Stress Reduction program demonstrated greater effectiveness in improving quality of life and glycemic indices. These findings highlight the importance of integrating contemporary psychotherapeutic approaches alongside pharmacological treatments in diabetes management.

Keywords: Type 2 diabetes, Mindfulness-Based Stress Reduction program, Acceptance and Commitment Therapy, quality of life, glycated hemoglobin (HbA1c)

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Introduction

Type 2 diabetes is a chronic metabolic disease that extends far beyond blood glucose dysregulation and imposes persistent psychological, behavioral, and quality-of-life burdens on affected individuals. The long-term nature of diabetes requires continuous adherence to medication, diet, physical activity, blood glucose monitoring, and medical follow-up, making diabetes management a complex biopsychosocial process rather

than a purely biomedical task (1). Women with type 2 diabetes may experience particular vulnerability because disease-related responsibilities often interact with family roles, emotional stress, self-care fatigue, and concerns about future complications. Diabetes-related complications, including neurological, vascular, gastrointestinal, and functional impairments, further intensify the psychological burden of the disease and may reduce perceived well-being and life satisfaction (2-4). Therefore, contemporary diabetes care increasingly emphasizes the integration of psychological interventions with conventional medical management.

Glycemic control, commonly assessed through glycated hemoglobin (HbA1c), is one of the most important indicators of diabetes management. However, HbA1c is influenced not only by pharmacological adherence and lifestyle behaviors but also by emotional distress, perceived stress, sleep problems, self-efficacy, and health-related behaviors. Psychological stress can activate neuroendocrine pathways that interfere with glucose regulation and may contribute to poor adherence to diabetes self-management behaviors (5). Empirical evidence has shown that stress and quality of life are associated with HbA1c among women with diabetes, indicating that psychological status is meaningfully related to metabolic outcomes (6). Similarly, psychological factors related to blood glucose control, including emotional regulation, coping capacity, and illness-related beliefs, have been identified as relevant determinants of diabetes outcomes (7). These findings suggest that improving psychological functioning may indirectly support better glycemic control.

Quality of life is a central outcome in type 2 diabetes because the disease affects physical functioning, emotional well-being, social participation, treatment satisfaction, and patients' perceptions of control over daily life. Diabetes distress is particularly important because it reflects the emotional burden, frustration, worry, and discouragement specifically associated with living with diabetes. Fisher et al. emphasized that diabetes distress becomes clinically meaningful when it disrupts self-care behaviors and emotional adaptation, making it a major target for intervention (8). In addition, insomnia and sleep-related difficulties have been associated with type 2 diabetes risk and disease burden, highlighting the importance of emotional and physiological regulation in this population (9). Internet-based self-management studies have also shown that psychological well-being is a key component of effective diabetes care, particularly when interventions aim to strengthen self-management skills and patient engagement (10).

Mindfulness-based interventions have attracted considerable attention in chronic disease management because they target stress reactivity, emotional regulation, body awareness, and nonjudgmental acceptance of internal experiences. The theoretical foundation of mindfulness-based stress reduction (MBSR) is rooted in the cultivation of present-moment awareness and the development of a different relationship with thoughts, emotions, bodily sensations, and stressors (11). Conceptual and empirical reviews have described mindfulness training as a clinical intervention capable of reducing distress and enhancing adaptive self-regulation across medical and psychological conditions (12). Mindfulness may influence health outcomes through mechanisms such as attentional control, exposure to internal experiences, emotional regulation, decentering, and reduced cognitive reactivity (13). These mechanisms are especially relevant for patients with diabetes because they may help individuals respond more effectively to stress, cravings, fatigue, illness-related fear, and self-care challenges.

Evidence from broader clinical research supports the effectiveness of mindfulness and meditation-based programs in reducing psychological stress and improving well-being. Meta-analytic findings have indicated

that meditation programs can produce beneficial effects on stress-related and psychological outcomes (14). Reviews of mindfulness and psychological health have similarly shown that mindfulness is associated with improvements in emotional regulation, depressive symptoms, anxiety, and overall psychological functioning (15). Shapiro et al. demonstrated that MBSR can improve mental health and self-care capacities, supporting its relevance for populations exposed to prolonged caregiving or chronic stress (16). Moreover, mindfulness has been linked to cardiovascular risk mechanisms, suggesting that its effects may extend to physiological pathways relevant to chronic metabolic conditions (17).

In diabetes-specific research, mindfulness-based interventions have shown promising effects on emotional distress, quality of life, diabetes-related distress, and metabolic control. Bogusch and O'Brien's meta-analytic review demonstrated that mindfulness-based interventions can improve diabetes-related distress and quality of life and may also contribute to better metabolic outcomes (18). The DiaMind randomized controlled trial showed that a mindfulness-based intervention reduced emotional distress and improved quality-of-life indicators in outpatients with diabetes, while also examining HbA1c as a key metabolic outcome (19). Tovote et al. reported that mindfulness-based cognitive therapy was effective for depressive symptoms in patients with diabetes, further supporting the use of mindfulness-oriented treatments for psychological difficulties in this group (20). Systematic reviews of mindfulness-based interventions in chronic illness have also confirmed their applicability across long-term medical conditions, including diabetes and related health problems (21, 22).

Acceptance and Commitment Therapy (ACT) is another third-wave behavioral intervention that has gained importance in chronic disease management. ACT is grounded in relational frame theory and aims to increase psychological flexibility, defined as the capacity to remain in contact with the present moment and act in accordance with personal values despite difficult thoughts, emotions, and bodily sensations (23). Rather than attempting to eliminate distressing internal experiences, ACT teaches acceptance, cognitive defusion, values clarification, committed action, self-as-context, and present-moment awareness. This model is particularly relevant for diabetes because patients often encounter persistent worries, treatment fatigue, frustration, fear of complications, and negative self-evaluations that may interfere with self-care. By strengthening psychological flexibility, ACT may help patients maintain health-promoting behaviors even when emotional discomfort is present.

The effectiveness of ACT has been demonstrated across psychological and health-related domains. Forman et al. showed that ACT can be effective for anxiety and depression, both of which commonly co-occur with chronic medical conditions and may interfere with diabetes self-management (24). Nemati found that ACT improved emotion control and health behaviors in patients with chronic diseases, indicating that acceptance-based processes may support adaptive behavior in long-term illness contexts (25). In diabetes-specific research, Shayeghian et al. reported that ACT improved self-management and HbA1c among patients with type 2 diabetes, suggesting that psychological flexibility may translate into both behavioral and metabolic benefits (26). A systematic review and meta-analysis by Sakamoto et al. further supported the efficacy of ACT for people with type 2 diabetes, reinforcing its value as a psychological intervention for this population (27).

Comparing MBSR and ACT is theoretically and clinically meaningful because both belong to contemporary behavioral and mindfulness-informed approaches, yet they emphasize different therapeutic processes.

MBSR primarily targets mindful awareness, stress reduction, nonjudgmental observation, and improved regulation of stress responses. In contrast, ACT focuses more explicitly on acceptance, defusion, values-based action, and psychological flexibility (11, 23). Both interventions may improve quality of life and glycemic control, but they may operate through partly distinct mechanisms. MBSR may be more directly linked to reducing physiological stress reactivity and enhancing body awareness, whereas ACT may be particularly effective in increasing adherence to self-care behaviors through values-based commitment. Therefore, comparative studies are needed to clarify whether one approach offers stronger benefits for specific outcomes such as quality of life and HbA1c.

Recent studies also support the relevance of stress management and acceptance-based interventions in patients with type 2 diabetes. Almasi et al. found that stress management and ACT improved psychological capital among patients with type 2 diabetes, suggesting that these interventions can strengthen positive psychological resources needed for chronic disease adaptation (28). Zernicke et al. demonstrated the feasibility of mindfulness-based online intervention in chronic illness contexts, showing that mindfulness-based care can be adapted to different delivery formats and patient needs (29). Although their work focused on cancer patients and survivors, the findings are relevant to chronic disease populations because they show the applicability of mindfulness-based models beyond traditional clinical settings. Collectively, this literature supports the inclusion of structured psychological interventions in chronic illness care, particularly when the goal is to improve both emotional and physiological outcomes.

Despite the growing evidence supporting MBSR and ACT, several gaps remain. First, many studies have examined these interventions separately, while fewer have directly compared their relative effectiveness in the same population and under similar methodological conditions. Second, although psychological outcomes such as distress, depression, and quality of life are commonly examined, fewer studies simultaneously include an objective glycemic control index such as HbA1c. Third, women with type 2 diabetes represent an important group because they may experience distinct psychosocial stressors, caregiving demands, emotional burdens, and barriers to self-care. Fourth, follow-up assessment is necessary to determine whether therapeutic gains remain stable after the intervention period. Addressing these gaps can help clarify whether mindfulness-based stress reduction or acceptance and commitment therapy produces stronger and more sustained improvements in quality of life and glycemic control.

Accordingly, the present study aimed to compare the effectiveness of Mindfulness-Based Stress Reduction and Acceptance and Commitment Therapy on quality of life and glycemic control index in women with type 2 diabetes.

Methods and Materials

Study Design and Participants

The present study employed a quasi-experimental design with pre-test, post-test, and follow-up assessments alongside a control group. The statistical population consisted of all women diagnosed with type 2 diabetes who attended the Charitable Association for the Support of Diabetic Patients in Tehran, Iran, between September and November 2024 and were under the supervision of endocrinologists or general practitioners. Participants had a confirmed medical diagnosis of type 2 diabetes and were between 30 and

55 years of age. In addition, all participants had at least one year of history of diabetes and reported difficulties related to self-care behaviors or quality-of-life functioning.

The sampling method used in this study was purposive convenience sampling. Initially, in collaboration with physicians, endocrinologists, and psychologists working at the diabetic support association, a list of eligible patients was prepared. Subsequently, through announcements, preliminary interviews, and screening questionnaires, participants who met the inclusion criteria were selected. Inclusion criteria included being female, having type 2 diabetes, absence of severe psychiatric disorders, not using specific psychotropic or antidepressant medications, and willingness to participate in therapeutic sessions. Based on the Krejcie and Morgan (1970) table, as well as the semi-experimental nature of the study involving two intervention groups and one control group, the sample size was determined to be 45 participants, with 15 individuals assigned to each group. Considering the possibility of attrition, 55 individuals were initially recruited; however, after participant dropout, the final statistical analyses were conducted using data from 45 participants. Participation in the study was entirely voluntary, all participants signed informed consent forms, and they were assured that their information would remain completely confidential throughout the research process.

Data Collection

The Diabetes Quality of Life Questionnaire (DQOL) was used to assess participants' quality of life. This questionnaire is considered one of the most valid instruments for evaluating quality of life among individuals with diabetes and was originally developed by the Diabetes Control and Complications Trial (DCCT) Research Group in Boston. The Persian version of the questionnaire was translated and psychometrically validated by Maleki et al. (2011). The instrument consists of 46 items distributed across four subscales, including life satisfaction, the impact of diabetes on daily life, diabetes-related worries, and treatment satisfaction. Responses are scored using a five-point Likert scale ranging from strongly agree to strongly disagree. In the psychometric study conducted by Maleki et al., the overall reliability of the questionnaire was reported to be 0.87 using Cronbach's alpha coefficient, indicating satisfactory internal consistency.

Glycated hemoglobin (HbA1c) testing was used as the medical indicator for assessing glycemic control. This laboratory test was conducted through blood sampling and reflects the average blood glucose level during the previous three months. HbA1c is recognized as one of the most reliable indicators of glycemic control and is strongly recommended by the American Diabetes Association for monitoring diabetes management. For individuals with diabetes, HbA1c values below 7% are generally considered indicative of appropriate glycemic control.

Intervention

The Mindfulness-Based Stress Reduction (MBSR) intervention was implemented in eight weekly group sessions, each lasting approximately 90 minutes. The intervention was based on Kabat-Zinn's mindfulness approach and focused on increasing participants' awareness of present-moment experiences in a nonjudgmental manner. Session contents included body scan exercises, mindful breathing, sitting meditation, mindful movement, awareness of thoughts and emotions, stress management techniques, and the application of mindfulness skills in daily life situations related to diabetes management. Participants

were also assigned home practice exercises at the end of each session to reinforce mindfulness skills and facilitate their application in everyday activities and self-care behaviors.

The Acceptance and Commitment Therapy (ACT) intervention was also conducted in eight weekly 90-minute group sessions. The treatment protocol emphasized increasing psychological flexibility through the six core processes of ACT, including acceptance, cognitive defusion, contact with the present moment, self-as-context, values clarification, and committed action. During the sessions, participants learned how to accept unpleasant thoughts and emotions related to diabetes rather than attempting to suppress or avoid them. Various experiential exercises, metaphors, mindfulness techniques, and value-oriented behavioral assignments were used to help participants improve emotional adjustment, increase adherence to self-care behaviors, and enhance overall quality of life.

Participants in the control group did not receive any psychological intervention during the study period and continued receiving their routine medical care and pharmacological treatment. After the completion of the study, educational materials related to stress management and psychological well-being were provided to members of the control group in order to maintain ethical considerations.

Data Analysis

In the descriptive statistics section, indices including mean, standard deviation, minimum, and maximum scores were calculated to describe demographic characteristics and participants' scores on quality of life and glycated hemoglobin across the pre-test, post-test, and follow-up stages. In the inferential statistics section, mixed repeated-measures analysis of variance was employed to examine the research hypotheses. This statistical method was considered the most appropriate approach due to the quasi-experimental nature of the study, the existence of three measurement stages (pre-test, post-test, and follow-up), and the inclusion of three groups (two experimental groups and one control group), allowing simultaneous examination of treatment effects over time and between-group comparisons. All statistical analyses were conducted using IBM SPSS Statistics, and the significance level for all statistical tests was set at 0.05.

Findings and Results

The demographic findings indicated that the participants in the three groups were relatively homogeneous in terms of age, age at diagnosis, marital status, educational level, and income status. The mean age of participants in the Mindfulness-Based Stress Reduction (MBSR) group was 44.50 years (SD = 4.52), while the Acceptance and Commitment Therapy (ACT) group had a mean age of 43.80 years (SD = 4.49), and the control group had a mean age of 45.03 years (SD = 4.59). In addition, the mean age at diagnosis of type 2 diabetes was 41.84 years (SD = 3.48) in the MBSR group, 42.26 years (SD = 4.40) in the ACT group, and 42.34 years (SD = 3.50) in the control group. The results of one-way analysis of variance demonstrated no statistically significant differences among the three groups regarding age and age at diagnosis, indicating baseline homogeneity of the study groups. Furthermore, chi-square analyses revealed no significant differences among the groups with respect to marital status, educational attainment, and income level.

Table 1. Descriptive Statistics for Age and Age at Diagnosis Across the Three Groups

Variable	Group	n	Mean	SD	F	Sig.
Age	MBSR	15	44.50	4.52	0.480	0.620
	ACT	15	43.80	4.49		
	Control	15	45.03	4.59		
Age at Diagnosis	MBSR	15	41.84	3.48	0.129	0.879
	ACT	15	42.26	4.40		
	Control	15	42.34	3.50		

The descriptive findings presented in Table 1 indicate that there were no statistically significant differences among the three groups regarding participants' age or age at diagnosis of diabetes. The results confirm that the groups were equivalent before the implementation of the interventions, thereby supporting the internal validity of the study design.

Table 2. Means and Standard Deviations of Glycated Hemoglobin (HbA1c) and Quality of Life Across Pre-test, Post-test, and Follow-up Stages

Variable	Group	Stage	Mean	SD	F	Sig.
HbA1c	MBSR	Pre-test	6.75	0.28	0.092	0.912
		Post-test	5.37	0.27	167.286	0.001
		Follow-up	5.28	0.35	163.615	0.001
	ACT	Pre-test	6.79	0.24		
		Post-test	4.88	0.53		
		Follow-up	5.39	0.38		
	Control	Pre-test	6.76	0.48		
		Post-test	6.77	0.28		
		Follow-up	6.79	0.24		
Quality of Life	MBSR	Pre-test	21.61	4.29	1.975	0.146
		Post-test	30.34	4.11	130.820	0.001
		Follow-up	26.57	4.39	64.563	0.001
	ACT	Pre-test	19.76	2.92		
		Post-test	38.15	4.00		
		Follow-up	32.42	3.43		
	Control	Pre-test	21.42	3.70		
		Post-test	21.26	3.09		
		Follow-up	20.88	3.02		

The findings presented in Table 2 showed that there were no statistically significant differences among the three groups in HbA1c and quality-of-life scores during the pre-test stage, indicating that the groups were homogeneous prior to intervention. However, statistically significant differences were observed during the post-test and follow-up stages for both variables. The mean HbA1c levels decreased substantially in both intervention groups, whereas the control group showed no meaningful changes over time. Similarly, quality-of-life scores increased significantly in both the MBSR and ACT groups compared to the control group. These findings indicate the effectiveness of both interventions in improving glycemic control and quality of life, with the therapeutic effects remaining relatively stable during the follow-up stage.

Before conducting repeated-measures analyses, the assumptions underlying mixed analysis of variance were examined. The results of Levene's test indicated that the homogeneity of error variances assumption was satisfied for most variables and measurement stages. Although the third measurement of quality of life showed a marginally significant value, the robustness of mixed repeated-measures ANOVA and the equality of sample sizes across groups supported continuation of the analysis. In addition, the normality of score distributions and independence of observations were examined and found to be acceptable for inferential analysis.

Table 3. Multivariate Analysis of Variance for Quality of Life and HbA1c

Source	Test	Value	F	Sig.	η^2
Between Groups	Pillai's Trace	1.548	34.256	0.001	0.774
	Wilks' Lambda	0.017	66.817	0.001	0.871
	Hotelling's Trace	25.343	123.095	0.001	0.927
	Roy's Largest Root	23.915	239.145	0.001	0.960
Time	Pillai's Trace	0.989	408.035	0.001	0.989
	Wilks' Lambda	0.011	408.035	0.001	0.989
	Hotelling's Trace	92.137	408.035	0.001	0.989
	Roy's Largest Root	92.137	408.035	0.001	0.989
Time × Group	Pillai's Trace	1.783	36.936	0.001	0.891
	Wilks' Lambda	0.005	61.226	0.001	0.933
	Hotelling's Trace	45.738	99.643	0.001	0.958
	Roy's Largest Root	41.575	187.089	0.001	0.977

Table 4. Post-Hoc Comparisons for Quality of Life and HbA1c

Variable	Group 1	Group 2	Mean Difference	SE	Sig.
Quality of Life	MBSR	ACT	-3.935	0.974	0.001
	ACT	Control	4.987	0.974	0.001
	MBSR	Control	8.923	0.974	0.001
HbA1c	MBSR	ACT	0.113	0.059	0.141
	MBSR	Control	-0.974	0.059	0.001
	ACT	Control	-1.874	0.059	0.001

The results of the multivariate analysis of variance demonstrated significant effects for group membership, time, and the interaction between time and group on the dependent variables of quality of life and HbA1c. The significant interaction effects indicated that changes across measurement stages differed significantly among the three groups. Post-hoc Tukey comparisons further revealed that both intervention groups differed significantly from the control group regarding quality of life and HbA1c outcomes. In terms of quality of life, the ACT group demonstrated significantly greater improvement compared to the MBSR group, while both interventions were significantly more effective than the control condition. Regarding HbA1c, no statistically significant difference was found between the two intervention groups; however, both MBSR and ACT showed significantly greater effectiveness than the control group in reducing glycated hemoglobin levels. Overall, the findings confirm the effectiveness and relative stability of both psychological interventions in improving glycemic control and quality of life among women with type 2 diabetes.

Discussion and Conclusion

The present study aimed to compare the effectiveness of Mindfulness-Based Stress Reduction (MBSR) and Acceptance and Commitment Therapy (ACT) on quality of life and glycemic control among women with type 2 diabetes. The findings demonstrated that both interventions significantly improved quality of life and reduced glycated hemoglobin (HbA1c) levels compared to the control group. In addition, the effects of both interventions remained stable during the follow-up phase, indicating the relative durability of treatment outcomes over time. The results further showed that ACT produced greater improvement in quality of life compared to MBSR, whereas no statistically significant difference was observed between the two intervention groups in reducing HbA1c levels. Overall, these findings support the effectiveness of third-wave psychological interventions in enhancing both psychological and physiological dimensions of diabetes management.

One of the most important findings of the present study was the significant improvement in quality of life among participants receiving MBSR and ACT. This result is consistent with previous research indicating that psychological interventions can positively influence emotional adaptation, daily functioning, and perceived well-being among patients with chronic illnesses. Diabetes often imposes substantial psychological burden because patients are required to continuously monitor their behaviors, adhere to dietary restrictions, manage medication schedules, and cope with fears regarding complications and disease progression. Such persistent demands may reduce life satisfaction and create emotional exhaustion. Therefore, interventions that enhance coping capacity and emotional regulation may significantly improve quality of life.

The effectiveness of MBSR in improving quality of life can be explained through the core mechanisms of mindfulness training. MBSR teaches individuals to observe thoughts, emotions, and bodily sensations in a nonjudgmental manner and to remain focused on present-moment experiences rather than engaging in maladaptive rumination or catastrophic thinking (11). Through mindfulness practice, patients may become more aware of emotional reactions related to diabetes management and develop healthier responses to stress. This interpretation is consistent with the findings of Keng et al., who emphasized that mindfulness interventions improve psychological health through mechanisms such as attentional regulation, emotional awareness, and reduced experiential avoidance (15). Similarly, Baer argued that mindfulness training can enhance adaptive coping and emotional regulation, thereby improving overall psychological functioning (12). The current findings also align with meta-analytic evidence indicating that mindfulness-based interventions contribute to improvements in quality of life among individuals with diabetes and chronic illnesses (18, 21).

Another explanation for the positive impact of MBSR involves the relationship between stress reduction and disease adaptation. Psychological stress has been strongly associated with poorer glycemic control and diminished quality of life among patients with type 2 diabetes (5, 6). Mindfulness training may reduce physiological and psychological stress responses by promoting relaxation, emotional acceptance, and cognitive flexibility. Goyal et al. reported that meditation-based interventions significantly reduce stress and improve well-being across clinical populations (14). Similarly, Loucks et al. proposed that mindfulness may influence health outcomes through mechanisms related to autonomic regulation, inflammatory processes, and behavioral self-regulation (17). Therefore, the reduction in diabetes-related stress observed among participants in the present study may have contributed to the improvement in quality of life.

The significant effectiveness of ACT in improving quality of life may also be understood through the concept of psychological flexibility. ACT emphasizes acceptance of unpleasant internal experiences and encourages individuals to act in accordance with personal values despite the presence of distressing thoughts or emotions (23). Patients with diabetes often experience frustration, fear of complications, hopelessness, and self-critical thoughts related to disease management. Attempts to suppress or avoid these experiences may intensify psychological distress and interfere with self-care behaviors. ACT helps individuals develop willingness to experience discomfort while maintaining engagement in meaningful and health-promoting actions. Consequently, patients may experience greater emotional adjustment and enhanced life satisfaction.

The greater effectiveness of ACT compared to MBSR in improving quality of life may reflect the strong behavioral and value-oriented components of ACT. Unlike mindfulness interventions that primarily focus on awareness and stress reduction, ACT explicitly targets value-based living and committed action. Women

with type 2 diabetes frequently experience conflict between disease demands and personal, family, and social roles. ACT may help patients reconnect with personal values and increase motivation to engage in meaningful activities despite chronic illness. This interpretation is consistent with the findings of Forman et al., who demonstrated that ACT effectively improves emotional functioning and psychological adaptation (24). In addition, Nemati found that ACT improved health behaviors and emotion control among individuals with chronic diseases (25). The findings of the present study are also congruent with those of Shayeghian et al., who reported significant improvements in self-management and glycemic outcomes following ACT among patients with type 2 diabetes (26).

Another major finding of the present study was the significant reduction in HbA1c levels among participants in both intervention groups. Glycemic control is influenced not only by biological and pharmacological factors but also by psychological and behavioral variables such as stress, adherence, motivation, emotional regulation, and self-care practices. Chronic psychological stress may increase cortisol secretion, interfere with metabolic regulation, and contribute to poor diabetes outcomes. Therefore, interventions that reduce stress and improve behavioral regulation may indirectly improve glycemic control.

The reduction in HbA1c among participants receiving MBSR may be explained by several interconnected mechanisms. Mindfulness training enhances awareness of bodily states and behavioral patterns, enabling patients to engage more consciously in self-care activities such as dietary adherence, medication use, and blood glucose monitoring. Moreover, mindfulness may reduce emotional eating, impulsive behaviors, and stress-related maladaptive coping patterns. Van Son et al. demonstrated that mindfulness-based interventions improve emotional distress and contribute to better diabetes-related outcomes, including HbA1c (19). Similarly, Tovote et al. reported beneficial effects of mindfulness-based cognitive therapy among patients with diabetes experiencing depressive symptoms (20). These findings support the argument that emotional regulation and stress reduction may contribute to improved metabolic outcomes.

The reduction in HbA1c among ACT participants may similarly reflect improvements in psychological flexibility and health-related behaviors. ACT encourages individuals to persist in meaningful health behaviors despite discomfort, fatigue, or discouraging thoughts. This process may improve adherence to diabetes self-management activities and reduce avoidance-based coping. Sakamoto et al. concluded in their systematic review and meta-analysis that ACT is effective for individuals with type 2 diabetes and can positively influence psychological and behavioral outcomes related to disease management (27). Furthermore, Almasi et al. found that ACT improved psychological capital among patients with type 2 diabetes, which may facilitate adaptive coping and treatment adherence (28). The current findings therefore provide additional evidence supporting the role of acceptance-based interventions in improving metabolic control among individuals with chronic illnesses.

The absence of a statistically significant difference between MBSR and ACT in reducing HbA1c is also noteworthy. Although the interventions differ theoretically, both appear capable of influencing psychological and behavioral processes associated with glycemic control. Both approaches reduce stress, enhance emotional regulation, and strengthen adaptive coping capacities. Consequently, their effects on HbA1c may converge despite differences in therapeutic emphasis. This finding supports the broader literature suggesting that multiple psychological pathways may contribute to improvements in diabetes outcomes. In addition, glycemic control is influenced by many external factors including medication adherence,

nutritional habits, physical activity, disease duration, and physiological characteristics. Therefore, although psychological interventions can contribute meaningfully to metabolic regulation, differences between interventions may not always appear large enough to reach statistical significance.

The stability of intervention effects during the follow-up stage is another important finding of the present study. Sustained improvement suggests that participants were able to internalize and continue applying therapeutic skills after the intervention period ended. Both mindfulness and acceptance-based interventions emphasize experiential learning and the development of enduring psychological skills rather than short-term symptom reduction. Participants may therefore continue using mindfulness exercises, acceptance strategies, and values-based behaviors in their daily lives following treatment completion. This interpretation aligns with the broader literature demonstrating long-term benefits of mindfulness and ACT interventions in chronic illness populations (23, 29).

The findings of the present study also support the growing emphasis on integrating psychological care into diabetes treatment programs. Diabetes management is not solely dependent on pharmacological intervention, and psychological well-being plays a fundamental role in treatment adherence, self-care behaviors, and disease adaptation. Studies have shown that emotional distress, depression, insomnia, and poor psychological functioning are associated with worse diabetes outcomes (8, 9). Therefore, interventions that improve emotional resilience and psychological flexibility may indirectly contribute to better medical outcomes and improved quality of life.

Despite the valuable findings of the present study, several limitations should be acknowledged. First, the sample size was relatively small, which may limit the generalizability of the findings to broader populations of women with type 2 diabetes. Second, participants were recruited through convenience sampling from a single diabetes support center in Tehran, which may reduce external validity. Third, the study relied partly on self-report measures, which are vulnerable to response bias and social desirability effects. Fourth, the follow-up period was relatively short, making it difficult to determine the long-term stability of intervention effects over extended periods. Finally, factors such as medication adherence, dietary patterns, physical activity, and family support were not fully controlled and may have influenced treatment outcomes.

Future studies are recommended to use larger and more diverse samples drawn from multiple medical centers and geographical regions to improve the generalizability of findings. Researchers should also investigate the long-term effectiveness of MBSR and ACT through extended follow-up periods lasting six months or one year. In addition, future investigations may compare these interventions across different demographic groups, including men, adolescents, and older adults with diabetes. Examining mediating variables such as self-efficacy, psychological flexibility, emotional regulation, and treatment adherence may also clarify the mechanisms underlying intervention effectiveness. Furthermore, integrating qualitative methods could provide deeper understanding of patients' lived experiences and perceptions regarding mindfulness- and acceptance-based interventions.

The findings of the present study suggest that psychological interventions should be incorporated into comprehensive diabetes management programs alongside pharmacological treatment and medical monitoring. Healthcare providers, psychologists, and diabetes educators may benefit from implementing structured MBSR and ACT programs in clinical and community health settings. Training patients in mindfulness skills, stress management, acceptance strategies, and value-based behaviors may improve

emotional well-being and promote more effective self-care practices. In addition, multidisciplinary collaboration among endocrinologists, psychologists, nurses, and counselors can enhance the holistic management of type 2 diabetes and improve both psychological and physiological outcomes among patients.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. This study was approved by the Ethics Committee of Islamic Azad University, North Tehran Branch under the ethical approval code IR.IAU.TNB.REC.1403.073.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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