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The Effectiveness of Mindfulness-Based Stress Reduction Training on Psychological Distress Tolerance, Sexual Function, and Psychosocial Distress in Diabetic Patients

Masoudeh. Timajchi[1], Mojgan. Agahheris[2*], Amin. Rafiepoor[2], Ezzatollah. Kordmirza Nikoozadeh[2]

1 Ph.D. Student of Health Psychology, International Branch, Payame Noor University, Tehran, Iran.
2 Associate Professor, Department of Health Psychology, Psychology Department, Payame Noor University, Tehran, Iran.

Corresponding author email address: m_agah@pnu.ac.ir

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ABSTRACT

Objective: This study aimed to determine the effectiveness of mindfulness-based stress reduction training on psychological distress tolerance, sexual function, and psychosocial distress in patients with type 2 diabetes.

Methods and Materials: The present study employed a quasi-experimental design with pre-test, post-test, and a two-month follow-up, including a control group. The statistical population consisted of all women with type 2 diabetes who attended Kasra Hospital in Tehran. In this design, 30 women were selected using purposive sampling based on inclusion criteria and were randomly assigned to either the experimental or control group. The experimental group received eight sessions of 90-minute mindfulness-based stress reduction training. Participants completed the Psychological Distress Tolerance Questionnaire, the Female Sexual Function Index, and the Diabetes-Related Psychosocial Distress Scale before, after the intervention, and after the follow-up phase. Repeated measures ANOVA and SPSS software version 24 were used to analyze the data.

Findings: The results indicated that mindfulness-based stress reduction training was effective in improving psychological distress tolerance (P<0.01), sexual function (P<0.01), and psychosocial distress (P<0.01) in diabetic patients.

Conclusion: Mindfulness-based stress reduction training can be used to help diabetic patients improve their psychological distress tolerance, sexual function, and psychosocial distress.

Keywords: Mindfulness-based stress reduction, distress tolerance, sexual function, psychosocial distress.

Introduction

Diabetes is associated with complications related to blood sugar levels. One of the short-term physical complications of diabetes is hypoglycemia, which refers to blood sugar dropping below 40 mg/dl. Activation of the sympathetic nervous system is an early sign of hypoglycemia (Rasha Abed et al., 2022; Ugli et al., 2024). In severe hypoglycemia, glucose becomes insufficient for neurological activity, leading to impaired consciousness, bizarre behavior, seizures, coma, and death (Christie et al., 2014). Diabetes is a contributing factor to increased psychological distress among those affected (Kuniss et al., 2021), and high levels of distress in diabetes are associated with the type of diabetes, type of treatment, blood sugar control, diabetes-related complications, and depression (Gonzalez et al., 2015). This distress can weaken treatment adherence in these patients,

complicating blood sugar control, and should be considered a separate medical condition requiring treatment and attention (Reddy et al., 2013). On the other hand, high distress tolerance in diabetic patients can be a protective factor, helping to improve their quality of life and mental health (Ammar et al., 2017; Coccaro et al., 2020). Therefore, improving psychological distress tolerance in diabetic patients should be a therapeutic goal.

In addition to distress tolerance, another factor that should be considered and treated in diabetic patients is sexual function. Studies have shown that sexual dysfunction is prevalent among both men and women with diabetes (Ammar et al., 2017; Bąk et al., 2017; Flotynska et al., 2019), including Iranian diabetic patients. Furthermore, women with diabetes suffer more from sexual dysfunction, which may be due to diabetic neuropathy/angiopathy and the type of insulin administration. Therefore, examining and treating sexual dysfunction in diabetic women is essential (Zamponi et al., 2020).

Additionally, diabetes is associated with psychological and social distress specific to the disease. Diabetes-related psychosocial distress includes the emotional burden of diabetes, distress related to the doctor-patient relationship, dietary distress, and interpersonal distress. Diabetic individuals with high diabetes-related psychosocial distress and low self-care behavior face increased blood sugar levels (Gonzalez et al., 2015; Hackett & Steptoe, 2017; Leavitt et al., 2019).

Given the interrelationship between diabetes and the mentioned variables, examining the role of psychological therapies on diabetes-related biological and physiological indices, such as blood sugar levels, sexual function, psychological distress tolerance, and diabetes-related psychosocial distress, is essential. Furthermore, considering that stress plays a role in the etiology of diabetes as both a predictor of new-onset diabetes and a prognostic factor in individuals with diabetes (Hackett & Steptoe, 2017), interventions that focus on relaxation and stress reduction, such as mindfulness-based stress reduction training, can be beneficial in improving diabetes and related factors (Whitebird et al., 2018).

Mindfulness-based stress reduction training is highly effective in managing diabetes and controlling blood sugar levels (Haji-Adineh et al., 2019), reducing blood sugar levels, and reducing diabetes-related distress (Whitebird et al., 2018). Mindfulness training enhances body awareness and alleviates psychological barriers, improving sexual function (Silverstein et al., 2011). Individuals with higher sexual mindfulness tend to have better self-esteem and greater satisfaction with their relationships, particularly women who experience higher sexual mindfulness and satisfaction with their sexual lives. Mindfulness enhances romantic and sexual relationships (Leavitt et al., 2019). This study aimed to determine whether mindfulness-based stress reduction training is efficacious in improving psychological distress tolerance, sexual function, and diabetes-related psychosocial distress.

Methods and Materials

Study Design and Participants

This study employed a quasi-experimental design with a pre-test, post-test, and two-month follow-up, including a control group. The statistical population was all women with type 2 diabetes referred to Kasra Hospital in Tehran. The required sample size for experimental and control groups was calculated using the following formula. However, due to the lack of precise statistics on the total number of women with type 2 diabetes visiting Kasra Hospital in Tehran, and considering that the minimum sample size in quasi-experimental studies is 30 individuals (15 for each experimental and control group: Delavar, 2019; Gall et al., 1996; Herzog, 2008), a sample size of 15 participants per group was also considered in this study. Therefore, a total of 30 women with type 2 diabetes referred to Kasra Hospital were selected through purposive sampling and were then randomly assigned to two experimental groups (each with 15 participants) and one control group (15 participants). The sampling method used was purposive sampling.

In this study, 45 women with type 2 diabetes referred to Kasra Hospital in Tehran were selected through purposive sampling and randomly assigned to two experimental groups (15 participants each) and one control group (15 participants). One experimental group (15 participants) underwent ten sessions (each lasting 60 minutes) of autogenic training based on the guidelines of Kanji (1977) and Schultz & Luth (1996). The second experimental group (15 participants) underwent eight sessions of 90-minute Mindfulness-

Based Stress Reduction (MBSR) training based on the protocol of Kabat-Zinn (2003), while the control group (15 participants) received no intervention.

The inclusion criteria for the study were: 1) confirmed diagnosis of diabetes by an endocrinologist based on blood test results; 2) no psychological treatment within the past three months to assess the actual impact of the current interventions without interference from recent psychological treatments; 3) receiving the same medical treatments; 4) absence of severe diabetes complications such as hand and foot ulcers, numbness, kidney failure, amputation, vision problems, dialysis, etc., which could hinder participation; 5) a minimum of one year of diabetes; 6) no psychiatric disorders as diagnosed by a psychiatrist; 7) no substance abuse, including opium, alcohol, cigarettes, etc., as substance use can affect blood sugar levels and psychological variables, potentially influencing the study results; 8) absence of any other physical diseases that could affect diabetes; and 9) informed consent to participate in the study. The exclusion criteria included: 1) having psychiatric disorders; 2) having other chronic physical diseases such as kidney failure, cardiovascular diseases, etc.; 3) having severe diabetes complications that could affect the study results; 4) missing more than two training sessions; 5) unwillingness to continue participation in the study; and 6) receiving other psychological treatments.

Instruments

Distress Tolerance Questionnaire: Developed by Simons and Gaher (2005) to assess psychological distress tolerance, this questionnaire consists of 15 items and four subscales: emotional distress tolerance, absorption by negative emotions, subjective distress appraisal, and regulation efforts to alleviate distress. Each item is rated on a five-point Likert scale from strongly agree = 1 to strongly disagree = 5. Higher scores indicate greater distress tolerance. The Cronbach's alpha coefficients for the subscales of emotional distress tolerance, absorption by negative emotions, subjective distress appraisal, and regulation efforts to alleviate distress were reported as 0.72, 0.82, 0.78, and 0.70, respectively, and the overall scale's Cronbach's alpha was 0.82. In Iran, Shams et al. (2010) reported a Cronbach's alpha of 0.67 and a test-retest reliability of 0.79 for this questionnaire. Dehaghani and Rahmati (2017) reported a Cronbach's alpha of 0.86. Mohammadi Kanjani and Rajabi (2015) reported Cronbach's alpha coefficients for the subscales of emotional distress tolerance, absorption by negative emotions, subjective distress appraisal, and regulation efforts to alleviate distress as 0.71, 0.72, 0.85, and 0.73, respectively (Abbasi Abrazgah et al., 2024).

Female Sexual Function Index (FSFI): This multidimensional instrument was first developed by Rosen et al. (2000). It is a widely used scale consisting of 19 items that assess female sexual function across six domains: sexual desire (2 items), sexual arousal (4 items), vaginal lubrication (4 items), orgasm (3 items), satisfaction (3 items), and pain (3 items). The scoring for each question related to sexual desire ranges from 1 to 5. In contrast, the scoring for each question related to sexual arousal, vaginal lubrication, orgasm, sexual satisfaction, and pain ranges from 0 to 5. The total score on this scale ranges from 4 to 95, with higher scores indicating better sexual function. The validity and reliability of this questionnaire have been confirmed in international studies, with its six-factor structure supported and a Cronbach's alpha of 0.95 reported. Soltanabadi et al. (2013) translated this scale into Persian, which reported a Cronbach's alpha of 0.89 (Moghtaderi Esfahani et al., 2024).

Diabetes-Related Distress Scale: To measure distress related to diabetes, the standard Diabetes Distress Scale was used. This scale, designed by Polonsky et al. (2005), contains 17 items that assess diabetes-related distress over the past month. Each item is rated on a seven-point Likert scale from 0 (never) to 6 (always). The scale assesses four domains of diabetes-related distress: emotional burden, physician-related distress, regimen-related distress, and interpersonal distress. The validity and reliability of this scale and its four-factor structure have been confirmed in international studies, with a reported Cronbach's alpha of 0.92 (Chin et al., 2017). Golshayan (2017) validated this scale in Iran, confirming its four-factor structure and overall validity. Furthermore, Shojaizadeh et al. (2012) reported a Cronbach's alpha of 0.75 for this questionnaire. Another study also reported a Cronbach's alpha of 0.92 for the Persian version of this scale (Bagheri Sheykhangafshe et al., 2021).

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Intervention

The MBSR training sessions were summarized as follows:

- **Session 1**: Introduction of participants, presentation of goals, adjustment of expectations, discussion about stress and diabetes and their reciprocal relationship, mindful eating with raisins, feedback, introduction to the automatic pilot system, body scan meditation, discussion about the experience, breathing space exercise, assignment of homework, and distribution of meditation CDs and educational materials.
- **Session 2**: Yoga stretching exercises, discussion of homework experiences and overcoming obstacles, body scan meditation, discussion about the meditation experience, and distribution of educational booklets.
- **Session 3**: Yoga and mindful sitting, discussion of mindful sitting, guided mindful walking, breathing space exercise, and distribution of educational booklets.
- **Session 4**: Mindful yoga; mindful sitting with awareness of emotions, feelings, thoughts, and bodily sensations; breathing space exercise; and distribution of educational booklets.
- **Session 5**: Body scan meditation; awareness of unpleasant events, emotions, thoughts, and bodily sensations; breathing space exercise; and distribution of educational booklets.
- **Session 6**: Mindful sitting; awareness of unpleasant events, emotions, thoughts, and bodily sensations; breathing space exercise; and distribution of educational booklets.
- **Session 7**: Four-dimensional meditation and awareness of whatever enters consciousness at the moment, mountain meditation, repetition of previous exercises, and distribution of educational booklets.
- **Session 8**: Body scan, program review, discussion of implemented programs, and summary.

Data Analysis

This study used descriptive statistics, including mean and standard deviation, and inferential statistics, including repeated measures analysis of variance (due to the follow-up period and repeated psychological and biological tests). Additionally, the assumptions of covariance analysis, such as normal distribution of data (Shapiro-Wilk test), homogeneity of variances (Levene's test), no multicollinearity (Pearson correlation test), homogeneity of regression slopes, linearity of regression between covariates and dependent variables, and homogeneity of variance-covariance matrices (Box's test), were examined. Data were analyzed using SPSS-24 software.

Findings and Results

The average age in the control group is 27.45, and in the Mindfulness-Based Stress Reduction (MBSR) group, it is 46.08. The results of a one-way ANOVA showed no significant difference in age between the groups ($P = 0.53$, $F(2, 42) = 1.28$), indicating that the groups are age-matched. The Kruskal-Wallis analysis also showed no significant difference between the two groups regarding education level, confirming homogeneity ($P = 0.18$, $\chi2 = 0.97$, $df = 2$). In the control and MBSR groups, 41%, 13%, and 41% were homemakers. The Kruskal-Wallis analysis found no significant difference in marital status between the two groups, confirming homogeneity ($P = 0.10$, $\chi2 = 1.11$, $df = 2$).

The descriptive statistics for the research variables in the pre-test, post-test, and follow-up stages are presented in Table 1. The comparison of the means in this table indicates that the average scores of the self-compassion training and MBSR groups in psychological distress tolerance, sexual functioning, and psychosocial distress in the post-test differ from the control group.

Table 1

Descriptive statistics of the variables studied by groups and stage

Variables	Group	Pre-test		Post-test		Follow-up	
		Mean	SD	Mean	SD	Mean	SD
Distress Tolerance	MBSR	41.26	16.13	58.86	5.66	48.86	2.44
	Control	35.93	7.81	36.86	9.10	38.06	6.74
Sexual Functioning	MBSR	39.66	15.29	72.13	4.79	63.61	2.77
	Control	38.40	17.67	41.60	9.36	44.33	8.17
Psychosocial Distress	MBSR	87.73	7.04	25.06	5.14	42.60	4.20
	Control	88.80	8.94	89.54	8.33	89.13	8.11

The data distribution in all three research groups, in all three stages (pre-test, post-test, and follow-up), was expected, allowing parametric tests to examine the research hypotheses. The results show that homogeneity of variances is achieved for all variables. Initially, a mixed multivariate ANOVA was conducted, examining within-group and between-group effects to investigate differences in distress tolerance scores between the MBSR and control groups. According to the M. Box test, the homogeneity assumption of variance-covariance matrices is met ($P > 0.05$, $F = 0.74$). Therefore, considering other preconditions reviewed in the previous step, all necessary assumptions for performing the mixed multivariate ANOVA are satisfied. With the confirmation of the M. Box test, Wilks' Lambda was used to evaluate multivariate effects. The multivariate test results are presented in Table 2, comparing the linear combination of the research variables' scores across groups over time and the interaction effects of group and time.

Table 2

Multivariate test results

Source of Variance	Wilks' Lambda	F	df Hypothesis	df Error	P	η^2
Time	0.53	11.98	2	27	0.001	0.47
Group × Time	0.44	17.20	2	27	0.001	0.56

As shown in Table 2, there is a significant difference in distress tolerance, sexual functioning, and psychosocial distress scores across the three instances of pre-test, post-test, and follow-up. Additionally, the second part of the results in this table indicates a significant difference in distress tolerance scores across the pre-test, post-test, and follow-up instances between the experimental and control groups. In other words, there is an interaction between time and group. The within-subject effects are examined after establishing a significant difference across the three instances (pre-test, post-test, and follow-up). However, before this, Mauchly's test of sphericity must be conducted to examine the homogeneity of covariance error matrices. The assumption of sphericity was not met for the research variables, so the Greenhouse-Geisser corrected repeated measures and ANOVA results were used.

Table 3

Univariate ANOVA results for distress tolerance, sexual functioning, and psychosocial distress scores

Variable	Source of Variance	SS	df	MS	F	P	η^2
Distress Tolerance	Time	1289.15	1.21	1058.74	10.54	0.001	0.27
	Group × Time	1082.75	1.21	889.23	8.58	0.001	0.24
	Groups	3635.37	1	3635.37	29.87	0.001	0.51
Psychosocial Distress	Time	15340.82	1.37	11196.93	374.52	0.001	0.93
	Group × Time	16020.95	1.37	11693.34	391.13	0.001	0.93
	Groups	31397.34	1	31397.34	276.42	0.001	0.90
Sexual Functioning	Time	5494.42	1.14	4821.44	35.27	0.001	0.55
	Group × Time	3268.69	1.40	2868.32	20.98	0.001	0.42
	Groups	6519.51	1	6519.51	31.06	0.001	0.52

Table 3 presents the within-group effects, showing that the effect of time on distress tolerance, sexual functioning, and psychosocial distress is significant (P = 0.001). In other words, there is a significant difference in distress tolerance, sexual functioning, and psychosocial distress across the pre-test, post-test, and follow-up stages. Additionally, the interaction effect between time and group is also shown to be statistically significant (P = 0.001). Therefore, distress tolerance levels interact with group levels, meaning that distress tolerance, sexual functioning, and psychosocial distress differ across different group levels. After establishing that there is a significant difference in pre-test, post-test, and follow-up scores between the experimental and control groups, the between-subject effects are examined. The results in Table 3 indicate a significant difference in distress tolerance, sexual functioning, and psychosocial distress scores between the experimental and control groups (P = 0.001).

Table 4

Bonferroni posthoc test results for distress tolerance, sexual functioning, and psychosocial distress across pre-test, post-test, and follow-up

Dependent Variable	Group Comparison	Mean Difference	SD	P	95% Confidence Interval
Distress Tolerance	Post-test vs. Pre-test	9.26	2.51	0.003	-15.65 to -2.87
	Pre-test vs. Follow-up	4.86	2.24	0.116	-10.58 to -0.84
	Post-test vs. Follow-up	4.40	0.94	0.001	1.99 to 6.80
Sexual Functioning	Post-test vs. Pre-test	17.83	2.79	0.001	-24.49 to -10.71
	Pre-test vs. Follow-up	14.93	2.65	0.001	-21.70 to -8.16
	Post-test vs. Follow-up	1.83	0.59	0.01	0.63 to 3.03
Psychosocial Distress	Post-test vs. Pre-test	14.16	2.51	0.001	6.30 to 21.49
	Pre-test vs. Follow-up	15.56	2.22	0.001	9.22 to 22.21
	Post-test vs. Follow-up	5.06	1.23	0.001	2.02 to 8.10

As shown in Table 4, the Bonferroni post-hoc test results indicate significant differences between the pre-test, post-test, and follow-up scores for distress tolerance, sexual functioning, and psychosocial distress. The significant difference in distress tolerance, sexual functioning, and psychosocial distress scores is more pronounced in the MBSR group than in the control group. These findings demonstrate that mindfulness-based stress reduction has a significant positive effect on distress tolerance, sexual functioning, and psychosocial distress.

Discussion and Conclusion

The results of the data analysis revealed that mindfulness-based stress reduction (MBSR) training has a significant role in increasing psychological distress tolerance in the experimental group. This finding aligns with the results of prior studies (Barghi Irani & Dehghan Saber, 2021; Biglari et al., 2022; Carpenter et al., 2019; Kashefizadeh et al., 2022).

In explaining the above result, it can be said that in this model, mindfulness involves intentionally focusing one's attention on the current experience in a non-judgmental and accepting manner, which can help reduce stress. Through mindfulness body techniques, patients learn how to gently redirect their attention from distress and agitation to a more desired focus. Patients learn to cultivate an awareness of themselves, their thoughts, and their bodies through body meditation, even if they are caught in repetitive cycles of ruminating thoughts and distress. Therefore, they can set aside their distress, react more appropriately to internal processes, and analyze emotional and cognitive experiences. Mindfulness-based methods aim to reduce the impact of restricted consciousness and specific disturbing emotional and behavioral effects of psychological experiences in patients (Kashefizadeh et al., 2022). Four components of mindfulness (observing, describing, acting with awareness, and non-judgmental acceptance) are associated with better description and identification of physical sensations and less anxiety and agitation. In the moment-to-moment awareness process, individuals strive to gain insight into patterns of thoughts, emotions, and interactions with themselves and others, allowing them to skillfully choose purposeful and beneficial responses instead of automatically reacting with ingrained and unconscious methods (Seyed Ali Tabar & Zadhasn, 2023). Additionally, individuals learn that they can achieve self-regulation through present-moment awareness, and this process and the enhancement of self-

regulation require high flexibility. This flexibility and acceptance are essential for achieving high acceptance. Through MBSR training, individuals gain appropriate psychological understanding and stress-coping strategies with a body-mind approach and explore ways to cope with life challenges. Therefore, in this intervention, patients are trained to apply their learning to the distress related to managing daily life challenges, increasing their ability to tolerate psychological distress.

The data analysis results also revealed that MBSR training has a significant role in improving sexual functioning in the experimental group. This finding aligns with the results of prior studies (Banbury et al., 2023; Brotto & Basson, 2014; Brotto et al., 2016; Jąderek et al., 2023; Pidad et al., 2024).

In explaining the effectiveness of the MBSR program on increasing marital satisfaction and functioning, it can be argued that this program, by enhancing individuals' mindfulness, makes it easier for them to accept their spouse's challenging states (Banbury et al., 2023). The MBSR program teaches skills such as focused breathing meditation, body scan, and yoga exercises, increasing individuals' moment-to-moment awareness of their feelings, thoughts, and bodily sensations. It teaches individuals to accept their inner states rather than reacting habitually and automatically and trying to escape the unpleasant state. With practice, individuals develop kindness and compassion for themselves and others, both intra-personally and interpersonally, leading to more conscious and desirable reactions. People with high mindfulness can better delay judgment and interact constructively with their spouse during difficult relationship experiences and conflicts. Mindfulness awareness and acceptance processes produce less emotional reactivity in interpersonal relationships, leading to more positive interactions between spouses (Lin et al., 2019). Additionally, mindfulness increases compassion and empathy, especially in understanding others' perspectives and showing empathetic concern (Larraz et al., 2023). Awareness of experiences related to mindfulness enhances the capacity for empathy towards others, thus improving relationship outcomes. Sexual mindfulness also improves romantic and sexual relationships. It has been shown that mindfulness, by encouraging individuals to increase their attention to sexual experiences and sensations, fosters more effective communication and then sharing these feelings or thoughts with their partner in a non-judgmental, open, and accepting manner, which can lead to improved overall and especially sexual functioning (Pidad et al., 2024). Therefore, mindfulness can be effective in addressing sexual dysfunctions and improving sexual functioning. It has also been shown that MBSR training, by targeting stress and reducing it through mindful meditation, can increase the capacity of patients to tolerate psychological distress, psychosocial adjustment to their illness, and reduce the pressure caused by the illness, thus improving sexual functioning.

The data analysis revealed that MBSR training significantly improves psychosocial distress in the experimental group. This finding aligns with the results of prior (Moradpour et al., 2023; Moulton-Perkins et al., 2022; Zhu et al., 2023).

It seems that the MBSR program in diabetic patients leads to accepting unfavorable life conditions and, consequently, increases their distress tolerance. In other words, these patients accept these situations during MBSR training to control existing stressors (Zhu et al., 2023). They are not seeking immediate relief from their distress or trying to avoid or tolerate situations that cause them distress. In other words, although patients cannot change their life circumstances, they can alter their level of distress related to stressful situations and life events. It is evident that all MBSR techniques reduce patients' distress, but it seems that the body meditation technique more clearly impacts patients' distress. During this technique, patients learn to connect directly with their physical sensations as they are and, most importantly, to be in the present moment, allowing their bodies to experience issues in the present time and space.

The sample group consisted of married women in Tehran, so generalizing the results to men should be done cautiously. This study was cross-sectional, and the data were limited to a specific time frame, so caution is needed when generalizing the findings. Self-report tools and questionnaires were used to collect information and assess changes in the subjects, which may introduce some bias into the results. The use of convenience sampling instead of random sampling, and thus the lack of control over potential confounding variables such as age, disease history, and socioeconomic factors, is another limitation of this study. The geographical

limitation of this study to Tehran makes it challenging to generalize the results to other regions. The exclusion of male diabetic patients could limit the results to female diabetic patients and hinder the generalization of the findings to all diabetic patients. It is suggested that in the field of health, MBSR training be used to help diabetic individuals address psychological problems and negative emotions resulting from the illness. It is recommended that MBSR training be used in diabetic individuals to improve blood sugar, psychological distress tolerance, sexual functioning, and psychosocial distress. It is suggested that MBSR training be integrated into the treatment and care programs for diabetic individuals to improve the general health status and quality of life of these patients.

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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. Ethical considerations in this study were that participation was entirely optional.

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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Authors' Contributions

All authors equally contributed to this study.

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