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RESEARCH ARTICLE

The mediating role of mindfulness in the relationship between alexithymia and glycemic control in patients diagnosed with type 2 diabetes mellitus

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ABSTRACT

Objective: This study examines the impact of alexithymia and mindfulness on diabetes management, focusing on how their relationship affects glycemic control in patients with type 2 diabetes mellitus (T2DM). It evaluates the challenges posed by alexithymia in managing diabetes and the mediating role of mindfulness in this process.

Method: The study included 100 T2DM patients aged 18-65 who had been diagnosed for at least one year, alongside 100 healthy controls. Data were gathered through a sociodemographic form, the Toronto Alexithymia Scale (TAS-20), and the Mindful Attention Awareness Scale (MAAS). Glycemic control was assessed using hemoglobin A1c (HbA1c) levels.

Results: The prevalence of alexithymia in diabetic patients was 67%. Alexithymic individuals showed higher HbA1c levels and poorer blood sugar control ($p<0.001$). HbA1c levels were also significantly higher in those with lower mindfulness ($p<0.001$). A strong negative correlation was found between alexithymia and mindfulness ($r=-0.789$, $p<0.001$). TAS-20 scores significantly correlated with HbA1c ($\beta=0.508$, $p<0.001$), while higher MAAS scores were linked to better glycemic control ($\beta=-0.674$, $p<0.001$). When MAAS was included in the model, the direct relationship between TAS-20 and HbA1c lost significance ($\beta=-0.024$, $p=0.85$), indicating a mediating role of mindfulness.

Conclusion: Mindfulness was associated with better diabetes management and glycemic control and glycemic control in individuals with alexithymia symptoms. Incorporating mindfulness-based strategies into psychosocial interventions could enhance quality of life and treatment adherence for these patients, underscoring the need for a holistic approach to diabetes care.

Keywords: Alexithymia, diabetes mellitus, HbA1c, mindfulness

INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder with increasing prevalence worldwide. Failure to control blood sugar levels can lead to long-term complications in individuals with T2DM. These complications can impact not only physical health but also mental health. It is estimated that more than 1.31 billion people will have diabetes by 2050, with age-standardized prevalence rates exceeding 10% in many

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regions (1). Among the psychosocial difficulties faced by patients with T2DM, alexithymia and changes in conscious awareness levels have an important place (2, 3). Alexithymia is defined as difficulty in recognizing, expressing, and understanding emotions. Chronic diseases such as diabetes can lead to significant changes in the emotional world of individuals, which can be associated with alexithymia. Alexithymic individuals have difficulty recognizing and expressing their emotional states, which can negatively affect disease management and overall quality of life (2). Rooted in deficits in affect regulation, social cognition, and interoceptive awareness, alexithymia has been associated with lower adherence to medical treatment, increased risk of complications, and diminished quality of life in patients with chronic diseases, including diabetes (4). While the present study focuses on the prevalence and impact of alexithymia within a diabetic population, it is important to note that alexithymia is not exclusive to medical contexts. A growing body of psychiatric literature identifies alexithymia as a transdiagnostic feature associated with emotional dysregulation across various psychiatric conditions. Recent studies have demonstrated strong links between alexithymia and bipolar disorder, particularly in relation to childhood trauma, impaired social cognition, and illness severity (5, 6).

Mindfulness is defined as an individual's ability to accept the present moment without judgment and is considered an important component of a healthy lifestyle (5). Mindfulness can increase individuals' ability to cope with stress, improve emotional regulation, and positively affect their overall health. In the context of diabetes, higher levels of mindfulness have been linked to better glycemic control, lower diabetes-related distress, and healthier lifestyle adherence (7). In diabetes management, increasing mindfulness can help patients better manage their own health and reduce disease-related stress (7). Importantly, growing evidence suggests an inverse relationship between mindfulness and alexithymia, with individuals high in alexithymia showing lower mindfulness. Multiple studies demonstrate that specific facets of mindfulness—such as acting with mindfulness, describing, observing, and non-judgment—are negatively correlated with alexithymia severity, suggesting that individuals with greater mindfulness skills are less likely to have difficulties identifying and describing emotions (6, 7). However, the joint impact of alexithymia and mindfulness on diabetes-related outcomes, particularly glycemic control, has not been sufficiently investigated. We hypothesized that mindfulness would mediate the relationship between alexithymia and glycemic control in individuals with type 2 diabetes mellitus. To address this gap, the present study aims to examine the relationship between alexithymia and mindfulness in individuals diagnosed with T2DM and to explore whether mindfulness mediates the relationship between alexithymia and glycemic control, as measured by HbA1c levels. By doing so, we hope to provide a more nuanced understanding of the psychological mechanisms underlying diabetes self-management and inform the development of integrative, psychosocially informed treatment strategies.

METHODS

Study Design and Sample

The study included 100 diabetic patients aged 18-65 who consecutively applied to the general internal medicine outpatient clinic of Recep Tayyip Erdogan University Training and Research Hospital (Rize, Turkiye) between 20.11.2021 and 20.05.2022, who had been diagnosed with T2DM for at least one year, and who agreed to participate in the cross-sectional study and met the inclusion criteria. The study inclusion criteria were meeting the diagnosis of T2DM, having no additional medical or neurological disease, not using psychotropic drugs for at least six months, not having an alcohol or substance use disorder, being between the ages of 18-65, not having a condition that prevents interviewing or administering the scale, and agreeing to participate in the study. All subjects participating in the study were informed about the study, and their written consent was obtained. The exclusion criteria for the study were not meeting the diagnosis of T2DM, having additional medical or neurological disease, use of psychotropic drugs within the past six months, having an alcohol or substance use disorder, being outside the age range of 18-65, having a condition that prevents interviewing or administering the scale, and not agreeing to participate in the study. The healthy control group of 100 people was composed of individuals who voluntarily agreed to participate in the study after being informed about its purpose and rationale, who had no previous or current history of psychiatric disease or treatment, who were hospital staff or patient companions, and who had similar characteristics to the patient group in terms of age, gender, and marital status.

Data Collection

Data were collected by the researchers by interviewing the patients in a suitable meeting room. The researcher verbally informed the patients about the research protocol, obtained verbal and written consent from the participants, and administered the questionnaire forms to those who agreed to participate. Completion of the questionnaire forms took an average of 30 minutes. In addition, the glycemic control parameters of the diabetic patients were obtained from the laboratory result documents regarding the measurements requested by their physicians during outpatient visits.

Measures

Questionnaire

A questionnaire form was prepared by the researchers using information from the literature to obtain data on the independent variables of the study, such as the sociodemographic characteristics of the patients and the clinical characteristics of the disease (duration of the disease, treatment used, complications).

Toronto Alexithymia Scale (TAS-20)

The Toronto Alexithymia Scale (TAS-20) is a 20-item self-report instrument developed by Bagby et al. (8) to assess alexithymic traits. The scale includes three subscales: DIF (Difficulty Identifying Feelings), DDF (Difficulty Describing Feelings), and EOT (Externally Oriented Thinking). Each item is rated on a 5-point Likert scale, and higher scores indicate greater alexithymic tendencies. In this study, individuals with a total TAS-20 score of 61 or above were classified as alexithymic, based on established cutoff criteria. The Turkish version of the scale, validated by Gulec et al. (9), has demonstrated good psychometric properties, with a total Cronbach's alpha of 0.78 and subscale alphas ranging from 0.57 to 0.80.

Mindful Attention Awareness Scale (MAAS)

The scale developed by Brown and Ryan (10) is used to measure people's awareness levels. The 6-point Likert-type scale, consisting of 15 items, is evaluated with a single total score. High scores indicate high conscious awareness. The internal consistency coefficient of the original scale was found to be 0.82, and the test-retest reliability was 0.81 (10). The scale was adapted into Turkish by Ozyesil et al. (11). The internal consistency coefficient of the Turkish version was 0.80, and the test-retest reliability was 0.86.

Blood Analyses

Hemoglobin A1c (HbA1c) levels were used to assess glycemic control. Venous blood was collected into ethylenediaminetetraacetic acid (EDTA) tubes for HbA1c analysis. The percentage of HbA1c in whole blood was measured using the Tosoh G8 high-performance liquid chromatography (HPLC) analyzer. According to the diagnostic criteria of the American Diabetes Association, diabetes was considered stable if the HbA1c value was <7% (12). For each participant, only a single HbA1c measurement was used to assess glycemic control, based on the most recent laboratory result available during outpatient evaluation.

Ethics Statement

The study's ethics committee approval was obtained from Recep Tayyip Erdogan University Non-Interventional Research Ethics Committee (Ethics Committee Decision Approval Date: 17.11.2021, Decision No: 2021/199). All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Statistical Analysis

To examine the difference between HbA1c values according to alexithymia levels between the groups, the required minimum sample size was calculated. The sample size calculation was performed using G*Power software (V. 3.1.9.2). In the power analysis, an α-error level of 0.05, 80% power (1-β), and an effect size of 0.45 (Cohen's d) were taken into account to reach statistical significance. Based on these parameters, the minimum sample size was calculated as n=152 to detect the difference between the groups. The effect size adopted was based on a previous study by Celik et al. (13) Data were analyzed using the Statistical Package for the Social Sciences (IBM Social Sciences Statistical Package SPSS, version 25.0) for Windows. The study data were evaluated using various descriptive statistical methods such as frequency, percentage, mean, and standard deviation. The Kolmogorov-Smirnov test was used to determine whether the variables were normally distributed. Categorical variables were compared using the Chi-square test. Independent samples t-test and one-way analysis of variance (ANOVA) were used for comparisons between groups. The homogeneity of the distribution of the data was assessed using the Levene test. When the data were homogeneously distributed, post hoc analyses were performed using the Tukey test. Correlations between variables were determined using the Pearson correlation test. Whether awareness was a mediator variable in the relationship between diabetes mellitus and alexithymia was evaluated using mediator model regression analysis. P values less than 0.05 were considered statistically significant.

RESULTS

Sociodemographic and Clinical Characteristics of Participants

A total of 100 patients with type 2 diabetes mellitus (DM) and a control group of 100 were included in our study. No significant difference was found between the case and control groups in terms of age, gender, education status, marital status, employment status, place of residence, or income level (p>0.05) (Table 1). Of the patients participating in the study, 52% were female and 48% were male. The mean age was 55.66±9.71. Among the participants, 64% were married, 15% were single, 10% were widowed, and 11% were divorced. In terms of education, 6% of the patients were illiterate, 24% were primary school graduates, 19% were secondary school graduates, 39% were high school graduates, and 12% were university graduates. Regarding treatment, 61% of the patients were receiving only oral antidiabetic medication, 13% were receiving only insulin, and 26% were receiving both oral antidiabetic and insulin treatment. While 58% of the patients did not develop any complications, 18% developed nephropathy, and 18% developed neuropathy (Table 1).

Alexithymia Characteristics of DM Patients

In patients with DM, the mean TAS score (66.65±10.92) was found to be higher than the scale's cut-off score. In the control group, the mean score was lower (46.25±13.63). A statistically significant difference was found between the two groups. According to the cut-off value of the scale, 67% of the patients were found to exhibit alexithymia symptoms. The TAS subscale scores were also statistically higher in the DM patient group (p<0.001) (Table 1). The alexithymic features of the patients did not differ according to sociodemographic characteristics such as gender, age range, marital status, education level, employment status, place of residence, people with whom they live, family type, and income level (p>0.05). The relationship between the clinical features of the patients and alexithymic features was found to differ according to hospitalization, treatment, and HbA1 level (p<0.001) (Table 2). While the mean Body Mass Index (BMI) in alexithymic individuals was 37.13±3.61, it was 34.23±3.39 in those without alexithymia. The difference between the groups in terms of BMI was statistically significant (t=-3.84, p<0.001). When HbA1c values were examined, the mean HbA1c level of alexithymic individuals was 8.81±1.55 compared to 7.74±1.48 in those without alexithymia. The significance of this difference between the groups (t=-3.28, p<0.001) indicates that blood sugar control is poorer in individuals with alexithymia (Table 2).

Mindfulness Characteristics of DM Patients

While the mean MAAS score in patients with DM was 44.41±9.01, it was 67.08±9.95 in the control group. The mean score in the DM group was statistically lower than in the control group (p<0.001) (Table 1). MAAS scores of individuals with alexithymia were significantly lower compared to those without alexithymia (40.51±7.65 and 52.33±5.85, respectively; t=7.82, p<0.001) (Table 2). A negative correlation was also observed between MAAS and HbA1c (r=-0.655, p<0.01) (Table 3).

The Relationship Between Alexithymia and Mindfulness in DM Patients

The relationship between the MAAS scores of the participants and the TAS-20 scores was examined using Pearson correlation analysis. A significant negative correlation was found between the MAAS scores and the TAS-20 scores (r=-0.789; p<0.00). The mean MAAS score of alexithymic patients (40.5±7.6) was lower than that of non-alexithymic patients (52.3±5.8, p<0.001). There was also a significant negative correlation between DIF and MAAS (r=-0.732, p<0.01). The DIF (r=-0.456, p<0.01) and EOT (r=-0.663, p<0.01) subscales also showed negative correlations with MAAS (Table 3).

Relationship Between Alexithymia and Glycemic Control in DM Patients

A significant positive correlation was found between TAS-20 total and subscale scores and HbA1c levels (r=+0.508; p<0.01). A significant positive correlation was found between Difficulty Identifying Feelings and HbA1c levels (r=+0.416; p<0.00). A significant positive correlation was also found between Difficulty Describing Feelings and HbA1c levels (r=+0.37; p<0.01) (Table 3).

Table 1: Demographic characteristics of the participants and MAAS, TAS-20 total and subscale scores

Variables	Patients (n=100)	Control (n=100)	Total (n=200)	Statistics	p
Gender, n (%)				χ^2=0.02[a]	0.887
Woman	52 (52)	51 (51)	103 (51.5)		
Man	48 (48)	49 (49)	97 (48.5)		
Marital status, n (%)				χ^2=1.144[a]	0.766
Single	15 (15)	20 (20)	35 (17.5)		
Married	64 (64)	63 (63)	127 (63.5)		
Divorced	10 (10)	8 (8)	18 (9)		
Widowed	11 (11)	9 (9)	20 (10)		
Education level, n (%)				χ^2=4.195[a]	0.38
Illiterate	6 (6)	3 (3)	9 (4.5)		
Primary education	24 (24)	30 (30)	54 (27)		
Secondary education	19 (19)	16 (16)	35 (17.5)		
High school	39 (39)	32 (32)	71 (35.5)		
University	12 (12)	19 (19)	31 (15.5)		
Working status, n (%)				χ^2=4.485[a]	0.344
Public	11 (11)	11 (11)	22 (11)		
Private	9 (9)	12 (12)	21 (10.5)		
Free	18 (18)	14 (14)	32 (16)		
Retired	32 (32)	22 (22)	54 (27)		
Unemployed	30 (30)	41 (41)	71 (35.5)		
Income level, n (%)				χ^2=3.713[a]	0.294
Bad	18 (18)	29 (29)	47 (23.5)		
Middle	42 (42)	33 (33)	75 (37.5)		
Good	27 (27)	26 (26)	53 (26.5)		
Very good	13 (13)	12 (12)	25 (12.5)		
Family type, n (%)				χ^2=0.452[a]	0.502
Large family	25 (25)	21 (21)	46 (23)		
Core family	75 (75)	79 (79)	154 (77)		
People living with, n (%)				χ^2=3.938[a]	0.268
Spouse and children	66 (66)	62 (62)	128 (64)		
Parents	11 (11)	20 (20)	31 (15.5)		
Caregiver	21 (21)	15 (15)	36 (18)		
Alone	21 (21)	15 (15)	36 (18)		
Place of residence, n (%)				χ^2=0.231[a]	0.631
Countryside	28 (28)	25 (25)	53 (26.5)		
City	72 (72)	75 (75)	147 (73.5)		
Age, Mean (SD)	55.66 (9.71)	55.01 (10.11)	55.42 (9.89)	t=0.335	0.738b
MAAS, Mean (SD)	44.41 (9.01)	67.08 (9.95)	55.74 (14.79)	t=-16.879	**<0.001[b]**
TAS-20, Mean (SD)	66.65 (10.92)	46.25 (13.63)	56.45 (16.01)	t=11.673	**<0.001[b]**
DIF, Mean (SD)	22.54 (4.34)	15.66 (5.24)	19.1 (5.91)	t=10.101	**<0.001[b]**
DDF, Mean (SD)	17.02 (3.22)	12.09 (4.53)	14.55 (4.63)	t=8.859	**<0.001[b]**
EOT, Mean (SD)	26.48 (5.74)	18.73 (6.73)	22.6 (7.35)	t=8.751	**<0.001[b]**

MAAS: Mindfulness Attention Awareness Scale; TAS-20: Toronto Alexithymia Scale; DIF: Difficulty Identifying Feelings; DDF: Difficulty Describing Feelings; EOT: Externally-Oriented Thinking; n: Number; SD: Standard deviation; a: Chi-Square Test for the comparison between study groups; b: Student's t Test for the comparison between study groups.

Table 2: Clinical features, MAAS, TAS-20 total and subscale scores in patients with and without alexithymia

Variables	Patients with alexithymia 33 (33%)	Patients without alexithymia 67 (67%)	Statistics	p
Treatment, n (%)			χ^2=13.225[a]	**<0.001**
OAD	28 (45.9)	33 (54.1)		
Insulin	0 (0)	13 (100)		
OAD+Insulin	5 (19.2)	21 (80.8)		
Hospitalization, n (%)			χ^2=12.183[a]	**<0.001**
Yes	7 (15.2)	39 (84.8)		
No	26 (48.1)	28 (51.9)		
Complication, n (%)			χ^2=6.831[a]	0.233
No	22 (37.9)	36 (62.1)		
Nephropathy	8 (44.4)	10 (55.6)		
Neuropathy	3 (16.7)	15 (83.3)		
Retinopathy	0 (0)	1 (100)		
Neph+Neu	0 (0)	4 (100)		
Neph+Ret	0 (0)	1 (100)		
HbA1c %, n (%)			χ^2=17.739[a]	**<0.001**
<7	13 (76.5)	4 (23.5)		
7–9	14 (25.9)	40 (74.1)		
>9	6 (20.7)	23 (79.3)		
Age, Mean (SD)	56.9 (9.49)	53.15 (9.82)	t=-1.834[b]	0.07
BMI, Mean (SD)	37.13 (3.61)	34.23 (3.39)	t=-3.846[b]	**<0.001**
HbA1c, Mean (SD)	8.81 (1.55)	7.74 (1.48)	t=-3.288[b]	**<0.001**
MAAS, Mean (SD)	40.51 (7.65)	52.33 (5.85)	t=7.821[b]	**<0.001**
TAS-20, Mean (SD)	72.7 (7.41)	54.36 (4.87)	t=-12.89[b]	**<0.001**
DIF, Mean (SD)	24.48 (3.69)	18.61 (2.56)	t=-8.201[b]	**<0.001**
DDF, Mean (SD)	18.09 (2.8)	14.85 (2.97)	t=-5.335[b]	**<0.001**
EOF, Mean (SD)	29.3 (4.31)	20.76 (3.67)	t=-9.764[b]	**<0.001**

OAD: Oral antidiabetic; Neph: Nephropathy; Neu: Neuropathy; Ret: Retinopathy; MAAS: Mindfulness Attention Awareness Scale; TAS-20: Toronto Alexithymia Scale; DIF: Difficulty Identifying Feelings; DDF: Difficulty Describing Feelings; EOT: Externally Oriented Thinking; BMI: Body Mass Index; a: Chi-Square Test for the comparison between study groups; b: Student's t Test for the comparison between study groups.

Associated Factors of HbA1c in DM Patients

In Table 4, tolerance, variance inflation factor (VIF), and condition index (CI) findings were examined to determine whether there was a multicollinearity problem among the independent variables, one of the prerequisites of multiple linear regression analysis. The results showed that there was no multicollinearity problem. In addition, whether the error values of the independent variables were independent of each other (autocorrelation problem) was examined using the Durbin-Watson value. The determined value of 1.869 indicated that there was no autocorrelation problem. Again, whether there were extreme values in the data was evaluated using Cook's distance. Since the largest value did not exceed 1 (max=0.001), it was concluded that there were no extreme values. When the regression findings in Table 4 were examined, the established model was found to be significant (F (6.93)=26.141; p=0.000), and the independent variables explained 62.8% of the change in the dependent variable (Adj. R^2). When the effects of the variables were examined in detail, it was found that MAAS and BMI significantly affected HbA1c levels (p<0.05), whereas DIF, DDF, EOF, and disease duration did not significantly affect HbA1c levels (p>0.05). MAAS negatively affected HbA1c, and a 1-unit increase in MAAS resulted in a 0.106-unit decrease in HbA1c (95% confidence interval: -0.146 to -0.067). BMI positively affected HbA1c, and a 1-unit increase in BMI resulted in a 0.206-unit increase in HbA1c (95% confidence interval: 0.141-0.272).

Table 3: Correlations (Pearson's r) for study variables									
Variable	**MAAS**	**TAS-20**	**DIF**	**DDF**	**EOT**	**HbA1c**	**Disease duration (years)**	**Age**	**BMI**
MAAS	1								
TAS-20	-0.789**	1							
DIF	-0.732**	0.923**	1						
DDF	-0.456**	0.795**	0.688**	1					
EOT	-0.663**	0.867**	0.709**	0.534**	1				
HbA1c	-0.655**	0.508**	0.416**	0.370**	0.460**	1			
Disease duration (years)	-0.210*	0.042**	0.004	-0.066	0.082	0.247*	1		
Age	-0.146	0.188	0.150	0.085	0.235	0.162	0.501**	1	
BMI	-0.461**	0.541**	0.411**	0.386**	0.511**	0.659**	0.088	0.094	1

MAAS: Mindfulness Attention Awareness Scale; TAS-20: Toronto Alexithymia Scale; DIF: Difficulty Identifying Feelings; DDF: Difficulty Describing Feelings; EOT: Externally-Oriented Thinking; BMI: Body Mass Index; *: Correlation is significant at the 0.05 level (2-tailed); **: Correlation is significant at the 0.01 level (2-tailed).

Table 4: Multiple regression analysis of HbA1c level									
Variables	**b**	**SE**	**ß**	**t**	**p**	**95% CI**		**Tolerance**	**VIF**
						Lower	**Upper**		
Constant	7.36	2.076		3.546	0.001	3.328	11.482		
MAAS	-0.106	0.020	-0.599	-5.389	**<0.001**	-0.146	-0.067	0.324	3.090
DIF	-0.075	0.038	-0.203	-1.948	0.054	-0.151	0.001	0.370	2.700
DDF	0.027	0.041	0.055	0.667	0.506	-0.054	0.108	0.597	1.676
EOT	-0.027	0.026	-0.097	-1.053	0.295	-0.078	0.024	0.474	2.109
Disease duration (years)	0.026	0.019	0.091	1.358	0.178	-0.012	0.065	0.889	1.125
BMI	0.206	0.033	0.487	6.241	**<0.001**	0.141	0.272	0.658	1.520

VIF: Variance inflation factor; MAAS: Mindfulness Attention Awareness Scale; TAS-20: Toronto Alexithymia Scale; DIF: Difficulty Identifying Feelings; DDF: Difficulty Describing Feelings; EOT: Externally-Oriented Thinking; BMI: Body Mass Index; SE: Standard error; CI: Confidence interval; F(6.93)=26.141; p=0.000; Adj. R^2: 0.628; Durbin-Watson=1.869.

Table 5: Mediator role of MAAS in the relationship between TAS-20 and HbA1c										
Predicted variable	**Predictor variable**	**R**	**R^2**	**Radj**	**B**	**SE**	**Beta**	**t**	**F**	**p**
HbA1c	TAS-20	0.508	0.258	0.251	0.074	0.013	0.508	5.84	34.15	**<0.001**
MAAS	TAS-20	0.789	0.623	0.619	-0.651	0.051	-0.789	-12.72	161.82	**<0.001**
HbA1c	MAAS	0.656	0.43	0.418	-0.012	0.022	-0.674	-5.4	36.56	**<0.001**
HbA1c	TAS-20	0.656	0.43	0.418	-0.003	0.018	-0.024	-0.19	36.56	0.85

SE: Standard error; MAAS: Mindfulness Attention Awareness Scale; TAS-20: Toronto Alexithymia Scale.

The Mediating Role of Mindfulness in the Relationship Between Glycemic Control and Alexithymia

To examine the mediating role of conscious mindfulness in the relationship between alexithymia and glycemic control, regression analyses were applied to the data. The model illustrating the relationship between the predictor variable (TAS-20), the predicted variable (HbA1c), and the mediator variable is illustrated in Figure 1. First, TAS-20 scores were entered into the equation as the predictor of HbA1c values, as shown in Figure 1. TAS-20 scores (β=0.508, b=0.074, p<0.001) were found to be a significant positive predictor of HbA1c (Table 5). TAS-20 explained 25% of the variance in the dependent variable (HbA1c) (R^2=0.25, F (34, 152)=65.59, p<0.001) (Table 5). Second, regression analysis was applied to examine the effect of TAS-20 scores on the mediator variable, MAAS scores. TAS-20 (β=-0.789, b=-0.651, p<0.01) significantly and negatively predicted the mediator variable, MAAS scores (Table 5). TAS-20 explained 62% of the variance in MAAS scores

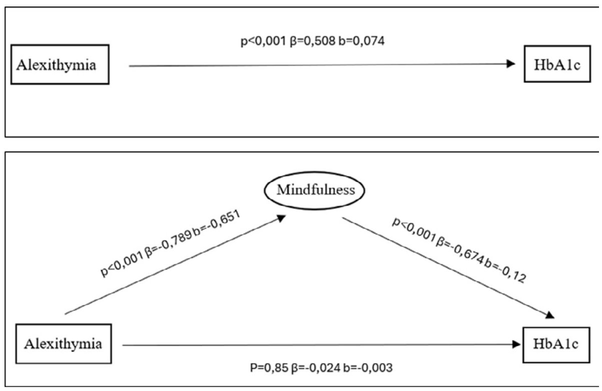

Figure 1. Structural equation modeling of the mediating role of mindfulness in the relationship between alexithymia and HbA1c.

(R^2=0.61, F (161.828)=5011.393, p<0.001) (Table 5). Finally, when TAS-20 scores and the mediator variable MAAS were simultaneously entered into the equation, MAAS was found to be a significant negative predictor of HbA1c values (β=-0.674, b=-0.12, p<0.001), while the significance of the relationship between TAS-20 scores (β=-0.024, b=0.003, p=0.85) and HbA1c was lost (F36.56)=54.54, p<0.001) (Table 5, Fig. 1).

DISCUSSION

Our study investigates the mediating role of mindfulness in the effect of alexithymia on glycemic control in a sample of diabetic patients and controls, based on the relationship between alexithymia and diabetes. To our knowledge, this is the first study to test the mediating role of mindfulness in the relationship between glycemic control and alexithymia. In our study, the prevalence of alexithymia was found to be 67% among patients with diabetes. Another study conducted in Turkiye in 2006 reported a prevalence rate of 65% in patients with diabetes (13). In another study conducted in 2022, this rate was determined as 63.9% (14). The prevalence of alexithymia in patients with type 2 diabetes mellitus varies between 25% and 75%. In reality, the prevalence of alexithymia varies among studies. This variability can reach up to 75%, depending on study designs and measurement tools, as well as the sociodemographic characteristics, geographical determinants, and cultural factors of the participants (15). This high prevalence is important because alexithymia is associated with poorer glycemic control and increased psychological distress. A systematic review by Martino et al. (3) reported that individuals with T2DM and alexithymia tend to have higher HbA1c and fasting glucose levels, indicating poorer glycemic control and an increased risk of diabetes-related complications. In patients with T2DM, alexithymic features have also been linked to hospitalization and the presence of diabetes-related complications. The higher prevalence of alexithymic features in patients with T2DM may therefore be related to both hospitalization of these patients and the presence of diabetes-related complications. Martino et al. (3) stated that alexithymic patients with T2DM generally have higher HbA1c and fasting blood glucose levels, indicating poorer glycemic control, which may lead to increased hospitalizations and complications. Additionally, Celik et al. (13) reported that alexithymia in diabetic patients was associated with lower perceived social support and poorer glycemic control, which in turn contributed to a greater risk of complications and hospitalizations. Mnif et al. (16) found that alexithymia in patients with T2DM increases the likelihood of complications requiring hospitalization, which can further exacerbate diabetes management difficulties. One of the important goals in diabetes management is to keep HbA1c, a parameter of glycemic control, at normal levels. However, various psychological and social factors, including alexithymia, play different roles in achieving glycemic control (14). In this study, it was found that the alexithymia levels of the participants were positively correlated with their HbA1c levels, and those with alexithymia symptoms had higher HbA1c levels. In parallel with this study, many previous studies have also determined that patients with alexithymia symptoms had poorer glycemic control (9, 11, 13). Luca et al. (17) showed that alexithymic patients with T2DM had significantly higher HbA1c levels compared with non-alexithymic patients (7.7±1.5 vs. 7±1.5, p=0.016), indicating poorer glycemic control. This study also found that the presence of alexithymia was a stronger predictor of poor glycemic control than depression (17). Gan et al. (18) found a significant positive correlation between alexithymia and HbA1c levels in patients with T2DM. The finding that nearly two-thirds of diabetic patients showed symptoms of alexithymia in our study is noteworthy in terms of demonstrating the prevalence of alexithymia. This situation is of great importance because it directly affects the capacity of diabetic patients to manage their disease and prevents them from receiving effective care and treatment. An important aspect of our findings concerns the distinct contributions of the TAS-20 subscales. The DIF subscale demonstrated the strongest positive correlation with HbA1c levels, suggesting that specific deficits in emotional awareness may be more closely tied to impaired glycemic regulation than other alexithymic features. This aligns with prior research indicating that emotional unawareness may interfere with illness self-monitoring and appropriate behavioral responses to physiological cues. Additionally, the EOT subscale showed a strong negative correlation with mindfulness (r=-0.663), reinforcing the theoretical opposition between externally directed cognitive styles and mindful present-moment awareness. These differential patterns suggest that tailored psychological interventions targeting specific facets of alexithymia—such as enhancing emotional awareness and reducing cognitive detachment—may be beneficial in improving diabetes self-management outcomes.

Mindfulness refers to focusing an individual's attention on the present moment without judgment and with acceptance. This skill can have positive effects on disease management in chronic diseases such as diabetes. Lower mindfulness scores were observed in patients with T2DM compared to the healthy control group. In addition, a negative relationship was found between mindfulness levels and HbA1c levels, with higher HbA1c levels in those with low mindfulness levels. The relationship between diabetes and mindfulness has been investigated in many studies. Loucks et al. (19) found that higher MAAS scores were associated with better glucose regulation, indicating that higher mindfulness may contribute to better metabolic control in individuals with diabetes. They also suggested that lower mindfulness may contribute to poorer metabolic control and potentially higher hospitalization and complication rates (19). This suggests that lower levels of mindfulness may be linked to poorer glucose regulation in patients with diabetes. Kiken et al. (20) found that lower levels of mindfulness, particularly during times of difficulty managing diabetes, were associated with higher accuracy in blood glucose predictions in patients with diabetes, suggesting that mindfulness is a crucial factor for effective diabetes management. Fanning et al. (21) reported that higher mindfulness was associated with better dietary behaviors in adults with type 2 diabetes. This suggests that lower mindfulness may negatively impact dietary habits, contributing to poorer glycemic control and an increased risk of complications (22). The American Diabetes Association's Standards of Care for Diabetes-2024 recommends integrating mindfulness-based interventions into diabetes self-management education and support programs and highlights their potential benefits in reducing diabetes distress and improving glycemic control (22).

In our study, higher mindfulness scores were significantly associated with lower alexithymia levels. Defined as difficulty identifying and describing emotions, alexithymia has been linked to deficits in interoceptive mindfulness and emotion regulation. Tamanaeifar et al. (23) found that mindfulness traits significantly predicted lower levels of alexithymia among university students (23). Similarly, a study conducted by Kumari et al. (24) found a negative correlation between dispositional mindfulness and alexithymia, with individuals demonstrating higher mindfulness exhibiting fewer alexithymic traits (24). In our study, high levels of mindfulness were also associated with low alexithymia in patients with T2DM. Aaron et al. (25) also stated that mindfulness interventions can increase interoceptive mindfulness, which is frequently impaired in individuals with alexithymia. Additionally, Liu et al. (26) determined that mindfulness mediates the relationship between self-control and alexithymia and suggested that increasing mindfulness could potentially reduce alexithymia in medical students. Overall, higher levels of mindfulness are associated with lower levels of alexithymia in diabetic patients. This finding highlights the importance of integrating mindfulness-based practices into the holistic management of diabetes.

The full mediating role of mindfulness in the relationship between alexithymia and glycemic control provides important insight into how these two variables affect each other. Alexithymia is a personality trait that reflects the inability of individuals to recognize and express emotions, and this deficiency can also complicate self-care processes such as diabetes management. Studies have shown that alexithymic individuals have higher HbA1c levels, indicating inadequate glycemic control (13). In our study, patients with alexithymic features were also found to have worse glycemic control. This demonstrates a direct relationship between alexithymia and glycemic control. On the other hand, mindfulness is an important factor in emotional regulation and stress management. It has been shown that mindfulness-based interventions can reduce HbA1c levels and improve emotional well-being in patients with diabetes (3, 17). Mindfulness can enhance the internal accuracy necessary for managing diabetes by increasing individuals' body mindfulness, enabling them to make more informed decisions about their blood sugar levels (20). The mediating role of mindfulness in the relationship between alexithymia and glycemic control can be explained through its effects on emotional regulation and stress reduction. Alexithymic individuals generally have poor stress-coping skills, which may negatively affect glycemic control. Mindfulness practices may help individuals become more aware of their emotional states and improve their stress coping skills (21). Reducing stress and increasing emotional mindfulness may allow individuals to be more effective in managing diabetes and more compliant with self-care behaviors (19). Individuals with alexithymia are less aware of their condition due to their inability to identify and describe emotions (27). Moreover, these individuals cannot concentrate on present experiences (28). In conclusion, mindfulness appears to be an important factor mediating the relationship between alexithymia and glycemic control. Mindfulness-based interventions may improve diabetes self-management and positively influence glycemic control by improving emotional regulation skills and reducing stress in individuals with alexithymia. These findings highlight the potential benefits of integrating mindfulness-based programs into clinical practice for individuals with diabetes and alexithymia.

To our knowledge, this is the first study to examine the mediating role of mindfulness in the relationship between alexithymia and glycemic control in patients with diabetes. This study also offers a different perspective on achieving glycemic control in parallel with the increasing prevalence of diabetes. However, this study has several limitations. The most important limitation is that it was conducted in a single institution during a specific time period and with patients who applied to this institution due to diabetes; therefore, the results of this study cannot be generalized. A second limitation of this study is that the information collected regarding alexithymia and mindfulness levels among the participants was based on the self-reports of these participants. Another limitation is that this study has a cross-sectional design and only explains the relationship between alexithymia, mindfulness, and glycemic control variables. However, longitudinal studies can more clearly reveal the cause-effect direction of the relationship between these variables and the dynamics between them. The mediation analysis was conducted using the Baron and Kenny method, which offers a clear and interpretable framework for exploratory research. Although this approach has known limitations—such as reduced statistical power—it was chosen due to the study's moderate sample size and cross-sectional design. Future studies are encouraged to replicate these findings using more robust techniques such as bootstrapping or structural equation modeling. Another limitation of this study is the lack of formal assessment for psychiatric comorbidities such as depression and anxiety. Although individuals with known psychiatric diagnoses or psychotropic medication use were excluded, undiagnosed psychiatric conditions may have been present and could have influenced levels of alexithymia, mindfulness, and glycemic control. Given the well-established associations between these comorbidities and the psychological variables examined, their omission represents a potential confounding factor. Future research should incorporate standardized psychiatric screening tools to more accurately account for these influences. It is recommended that future studies be conducted with larger and more diverse sample groups and use different data collection methods.

CONCLUSION

This study highlights an association between mindfulness, alexithymia, and glycemic control in patients with type 2 diabetes. Individuals with higher alexithymia scores tended to exhibit poorer glycemic control, while lower mindfulness levels were associated with higher HbA1c values. Mindfulness appeared to mediate the relationship between alexithymia and glycemic control. These findings underscore the potential relevance of psychosocial factors in diabetes management. However, given the observational nature of the study, these results should be considered preliminary and associative rather than causal. Future research, including longitudinal and interventional studies, is needed to clarify the directionality and underlying mechanisms of these relationships. Nevertheless, incorporating assessments of alexithymia and mindfulness into comprehensive diabetes care may help inform tailored psychosocial interventions aimed at improving patients' quality of life and metabolic outcomes.

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