

# Evaluation of the relationship between loneliness and medication adherence in patients with diabetes mellitus: A cross-sectional study

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## Abstract

**Objective:** The emotional status of patients with diabetes mellitus (DM) is important in the course of treatment. The present study aimed to determine the level of loneliness among patients with DM and to evaluate the relationship between the patients' level of loneliness and medication adherence.

**Method:** This cross-sectional study used a semi-structured questionnaire and the University of California, Los Angeles Loneliness Scale to collect data from 325 patients who were diagnosed with DM.

**Results:** We found that loneliness scores were significantly elevated in individuals with a low level of education, unmarried individuals, and students. Furthermore, these scores were elevated in patients diagnosed with type I DM, patients on insulin therapy, patients diagnosed with diabetic foot syndrome, patients who did not exercise regularly, and patients who reported being disturbed by reminders from their families or spouses to take their medications or they did not feel anything after such reminders.

**Conclusions:** Individuals with DM may encounter various problems in their daily lives. Evaluating the emotional status in these individuals, including loneliness and treatment adherence, is important in ensuring that their needs are being met.

## Keywords

Loneliness, diabetes mellitus, relationship, medication adherence, plasma glucose, University of California, Los Angeles Loneliness Scale (UCLA LS)

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## Introduction

Diabetes mellitus (DM) is a lifelong chronic disease that affects individuals of all ages, as well as their families and relatives. DM is associated with several severe complications and may lead to a serious economic burden. DM affects self-care activities, shortens life, and leads to different medical and psychosocial problems. According to the International Diabetes Federation, DM is one of the largest global emergency health problems. Approximately 415 million people or 8.8% of the global adult population aged between 20 and 79 years have DM. There are 318 million adults with glucose intolerance, the risk for the developing diabetes in these individuals is increased, and approximately 75% of them live in low and middle-income countries.<sup>1</sup>

Loneliness is defined as a unique psychological structure that is characterized by feelings of sadness due to the absence or lack of expected meaningful interpersonal relationships.<sup>2</sup> Loneliness is an important indicator of psychological problems and is associated with general morbidity and mortality in the adult population. Loneliness may lead to chronic conditions, such as heart disease, hypertension, stroke, obesity, diabetes, and pulmonary disease.<sup>3-11</sup>

A two-way interaction has been identified between loneliness and diabetes. The complications of this association with diabetes lead to a decrease in physical activity and a reduction in the search for social interaction. This may bring tension to a marriage, and to relationships with family and friends, resulting in loneliness. In contrast to this situation, systemic inflammation due to stress, which is observed in lonely patients, is known to be a risk factor, leading to poor health outcomes associated with diabetes. Therefore, a high rate of loneliness has a detrimental effect on diabetic outcomes.<sup>11-15</sup>

The present study aimed to determine if the mean loneliness score of patients varies depending on sociodemographic variables or diabetes-specific characteristics. This study also aimed to investigate whether the loneliness score of patients with DM is correlated with age, haemoglobin A1c (HbA1c), body mass index (BMI), fasting plasma glucose, or postprandial plasma glucose levels. Furthermore, this study examined if there is any relationship between patients' loneliness scores and their feelings after being warned by their family members or spouses to take their diabetes medication, depending on their age, sex, or marital status. The present research contributes to the literature in determining the loneliness levels of patients with DM, and in showing the relationship between loneliness levels and medication adherence.

## Method

### *Study participants*

This cross-sectional study was conducted on patients who were admitted to the outpatient clinics of the Department of Family Medicine and Endocrinology and the Department of Metabolism at a university hospital between January 2017 and August 2017. The population of this study was selected through a random sampling method. Based on the standard deviation of the University of California, Los Angeles Loneliness Scale (UCLA LS) of 20 as identified in previous studies,<sup>16-19</sup> the minimum required sample size was estimated to be 317, with a 95% confidence interval and a 5% type-I error rate. The test power was considered as 80% and the effect size was assigned a value of 2.2 based on the following formula:  $n = Z\alpha^2 \cdot \sigma^2 / d^2$  ( $n = 1.962 \cdot 202 / 2.22$ ). A total of 333 individuals were interviewed for the study, considering an estimated non-responder rate of 5%, and a total of 325 participants agreed

to participate. Inclusion criteria for eligible patients were as follows: (1) previously diagnosed with diabetes, (2) 18 years or older, (3) able to speak and understand, and not too confused or ill to complete the questionnaire, and (4) willing to participate in this study.

A semi-structured questionnaire and the UCLA LS were used to collect data.

### **Questionnaire**

The study data were collected from a questionnaire that was filled in by the researchers during face-to-face interviews. The questionnaire was developed by the researchers after reviewing relevant literature and conducting a pilot study. Before being subjected to the questionnaire, the participants were informed about this study, and their informed consent was obtained. If the participants were illiterate, written informed consent was obtained from their proxies. Detailed information was collected about the respondent's age, sex (female/male), education level, height, weight, family relationships, marital status, socioeconomic status, employment status, place of residence (e.g., with parents, with friends, alone, dormitory), type of diabetes, duration of diabetes, treatment regime, the presence of complications due to diabetes, regular diet, regular exercise, HbA1c levels, fasting blood glucose levels, postprandial blood glucose levels, and feelings of single/married individuals after their families/spouses warned them about the treatment.

### **UCLA LS**

The UCLA LS was developed by Russell, Peplau, and Cutrona<sup>20</sup>, and comprises 20 items, 10 of which are coded in a straightforward direction, and 10 in a reverse direction. The respondents were asked to indicate how often they experienced particular situations, scoring each item on a

quadruple Likert-type scale. The maximum score on the scale was 80, and the minimum score was 20, with a high score indicating an increased loneliness level. According to Perry's loneliness classification scheme, a score of 65 to 80 indicates a severe high degree, 50 to 64 indicates a moderately high degree, 35 to 49 indicates a moderate degree, and 20 to 34 indicates a low degree of loneliness.<sup>21</sup>

In Turkey, the validity and reliability of the UCLA LS were determined by Demir<sup>22</sup>, and the Cronbach's alpha internal consistency was found to be 0.95 for this study.

### **Statistical analysis**

The data were evaluated using the Kolmogorov–Smirnov normality test, while parametric tests were used for normal distribution and nonparametric tests were used for non-normal distribution. Statistical analysis was performed using IBM SPSS Statistics, version 22 (IBM Corp., Armonk, NY, USA).

Categorical measurements are expressed as number and percentage, and numerical data are presented as mean and standard deviation. Data assessment of independent samples was carried out using multivariate tests (MANOVA), one-way analysis of variance (ANOVA) and Pearson correlation analysis. MANOVA was used to evaluate the measured continuous variables (age, BMI, HbA1c, fasting plasma glucose, and postprandial plasma glucose) based on categorical variables (sex, marital status, working status, DM type, DM duration, treatment type, complication status, death, and exercise status). As prerequisites for the ANOVA test, normal distribution and variance homogeneity were demonstrated for the groups. ANOVA was used to test for any significant differences between the mean values of the groups. A *p* value of < 0.05 was considered statistically significant.

### Ethical considerations

Ethical approval was obtained from the Faculty of Medicine of a state university Ethics Committee (REC/REF: 04/12.01.2017). All participants gave their written consent to be included in this study, which was conducted in accordance with the principles of the Declaration of Helsinki.

### Results

While 89.2% (n=290) of the participants were married and living with their spouses,

the remaining 10.8% were single, divorced, or widowed. None of the participants was living alone (Table 1). The mean age of the patients was  $52.40 \pm 13.93$  years (minimum = 18, maximum = 85 years), the mean BMI was  $28.46 \pm 4.92$  kg/m<sup>2</sup>, and the mean HbA1c value was  $8.90\% \pm 2.25\%$  ( $74 \pm 1$  mmol/mol).

When the level of loneliness was evaluated based on the Perry classification, 4% (n=13) of the patients were severely lonely, 9.2% (n=30) had a moderately high level of loneliness, 21.8% (n=71) had moderate loneliness, and 34.1% (n=111) had a low level of loneliness.

**Table 1.** Comparison of the mean loneliness scores according to the sociodemographic characteristics of the patients (n = 325)

	Patients, n (%)	UCLA LS score, Mean $\pm$ SD	p	F
Sex			0.059	3.594
Female	184 (56.6)	42.73 $\pm$ 13.56		
Male	141 (43.4)	39.89 $\pm$ 13.14		
Age (years)			0.058	2.867
18–39	63 (19.4)	44.76 $\pm$ 12.93		
40–59	153 (47.1)	39.99 $\pm$ 13.13		
$\geq 60$	109 (33.5)	41.73 $\pm$ 13.91		
Education level			0.001*	4.096
Illiterate	116 (35.7)	43.89 $\pm$ 13.37		
Literate	31 (9.5)	41.58 $\pm$ 14.10		
Primary school graduate	77 (23.7)	43.23 $\pm$ 14.05		
Secondary school graduate	36 (11.1)	40.31 $\pm$ 11.94		
High school graduate	40 (12.3)	37.98 $\pm$ 11.59		
University graduate	25 (7.7)	32.36 $\pm$ 11.54		
Marital status			0.001*	16.203
Married	290 (89.2)	40.48 $\pm$ 12.76		
Single, divorced, widowed	35 (10.8)	49.94 $\pm$ 15.95		
Socioeconomic status			0.521	0.654
Equal income and expenses	136 (42.2)	40.68 $\pm$ 13.24		
Income more than expenses	92 (28.6)	41.70 $\pm$ 14.19		
Income less than expenses	94 (29.2)	42.74 $\pm$ 13.12		
Employment status			0.001*	12.330
Not employed	203 (62.5)	43.99 $\pm$ 13.90		
Student	10 (3.1)	46.00 $\pm$ 6.11		
Employed	112 (34.5)	36.59 $\pm$ 11.61		

F, one-way analysis of variance. \*p < 0.05.

UCLA LS, University of California, Los Angeles Loneliness Scale; SD, standard deviation.

The measured continuous variables, including age, BMI, HbA1c, fasting plasma glucose, and postprandial plasma glucose, were considered together and tested based on categorical variables using multivariate analysis of variance (MANOVA) tests. These analyses showed no significant differences between these continuous variables and the socioeconomic level ( $\lambda=0.873$ ;  $p=0.107$ ). MANOVA analyses showed significant differences between the continuous variables and sex ( $\lambda=0.874$ ;  $p=0.003$ ), marital status ( $\lambda=0.853$ ;  $p=0.002$ ), education status ( $\lambda=0.873$ ;  $p=0.107$ ), working status ( $\lambda=0.828$ ;  $p=0.013$ ), DM type ( $\lambda=0.483$ ;  $p<0.001$ ), DM duration ( $\lambda=0.622$ ;  $p<0.001$ ), treatment type ( $\lambda=0.544$ ;  $p<0.001$ ), presence of complications associated with DM ( $\lambda=0.204$ ;  $p<0.001$ ), following a diet ( $\lambda=0.779$ ;  $p=0.001$ ), and regular exercise ( $\lambda=0.847$ ;  $p=0.034$ ).

No significant differences were observed in the mean loneliness scores between the sexes and age groups. However, loneliness scores were significantly higher in individuals whose level of education was secondary school graduate and lower, in those who were not married (single, widowed or divorced), in those who were not employed, and in students (all  $p<0.001$ , Table 1). The mean loneliness scores were significantly higher in patients with type 1 DM, in individuals who were using insulin or oral anti-diabetics along with insulin, in patients who were receiving treatment for diabetic foot syndrome, and in patients who did not exercise regularly (all  $p<0.01$ , Table 2).

The mean loneliness score in patients who stated that their blood glucose levels were badly affected by their family life was significantly higher than that in patients who reported that their blood glucose levels were not affected by their families ( $p=0.018$ ,  $F=4.063$ ) (Table 3). Similarly, the mean loneliness score in patients who reported that their blood glucose levels were badly affected by their

business life was significantly higher than that in patients who reported that their blood glucose levels were not affected by their business life ( $p=0.019$ ,  $F=4.194$ ).

The mean loneliness score of patients who stated that they had difficulties in adapting to diet therapy was significantly higher than that in patients who stated that they had no difficulties in the adaptation process ( $p=0.001$ ,  $F=7.752$ ) (Table 3). Similarly, the mean loneliness score in patients who noted that they had difficulties in adapting to exercise therapy was significantly higher than that in patients who stated that they had no difficulties in the adaptation process ( $p<0.001$ ,  $F=12.640$ ). The mean loneliness score in patients who said that they had difficulties in medication adherence, similar to adaptation to diet and exercise therapy, was significantly higher than that in patients who noted that they had no difficulties in the adaptation process ( $p=0.021$ ,  $F=3.927$ ).

A significant positive correlation ( $r=0.147$ ;  $p=0.01$ ) was observed between the loneliness score and postprandial blood glucose levels of the patients (Table 4).

The associations between UCLA LS scores and the patients' responses when reminded by their families or spouses to take their medication, and their diet and exercise for DM are shown in Table 5. Among the patients who reported that they were very happy to be reminded by their family members or spouses to take their medicines, the mean loneliness scores were not significantly different based on age, sex or marital status. Among patients who reported not feeling anything or feeling modestly happy after receiving a reminder, the loneliness scores were significantly elevated in single patients ( $p=0.011$ ,  $p=0.004$ , respectively) and in women ( $p=0.01$ ,  $p=0.008$ , respectively) in both groups. Among patients who reported feeling uncomfortable with being reminded, the mean loneliness score was significantly higher in the 18–39 years age group than

**Table 2.** Comparison of mean UCLA LS scores according to the DM characteristics of the patients (n = 325)

	Patients, n (%)	UCLA LS score, mean $\pm$ SD	p	F
Type of diabetes			0.001*	8.400
Type 1 DM	52 (16)	45.72 $\pm$ 11.49		
Type 2 DM	270 (83.1)	40.51 $\pm$ 13.31		
Maturity-onset diabetes of the young	3 (0.9)	34.67 $\pm$ 13.43		
Duration of diabetes			0.129	1.796
Less than 1 year	46 (14.2)	41.52 $\pm$ 13.74		
1–5 years	89 (27.5)	39.20 $\pm$ 12.20		
6–10 years	90 (27.8)	41.07 $\pm$ 13.98		
11–20 years	86 (26.5)	44.53 $\pm$ 13.94		
21+ years	13 (4.0)	41.77 $\pm$ 10.10		
Treatment regime			0.001*	7.687
Insulin	117 (36.0)	45.51 $\pm$ 15.27		
Oral antidiabetics	141 (43.4)	40.06 $\pm$ 11.97		
Insulin and oral antidiabetics	12 (3.7)	44.42 $\pm$ 12.84		
Others	55 (16.9)	36.04 $\pm$ 10.24		
The presence of complications due to diabetes			0.003*	3.349
Retinopathy	28 (10.5)	35.96 $\pm$ 9.57		
Nephropathy	4 (1.5)	37.50 $\pm$ 14.79		
Neuropathy	18 (6.8)	38.78 $\pm$ 12.11		
Diabetic foot	20(7.5)	52.25 $\pm$ 16.04		
Do you pay attention to your diet?			0.356	1.037
Yes	118(38.2)	40.46 $\pm$ 13.57		
Sometimes it is delayed	204(45.3)	41.57 $\pm$ 12.55		
No	74(16.4)	43.67 $\pm$ 15.54		
Do you exercise regularly?			0.001*	7.781
Yes	45(13.8)	37.00 $\pm$ 11.36		
Sometimes, irregularly	73(22.5)	38.15 $\pm$ 8.72		
No	207(63.7)	43.66 $\pm$ 14.72		

F, one-way analysis of variance. \*p < 0.05.

DM, diabetes mellitus; UCLA LS, University of California, Los Angeles Loneliness Scale; SD, standard deviation.

in the other age groups (p=0.041) (Table 5). When the level of loneliness was evaluated based on the Perry classification, irrespective of the patients' responses to reminders to take their medications, the level of loneliness was moderate or high at all ages, in both sexes, and in both marital status groups (UCLA scores of 35–49). Additionally, patients who suffered from loneliness at a high degree and at moderately high degree (UCLA scores of  $\geq$ 50) were single patients who reported feeling nothing or were uncomfortable after receiving

reminders, and patients aged 18–39 years who reported feeling uncomfortable after being reminded.

## Discussion

The treatment period of DM is significantly affected by many factors. These factors include treatment duration, the possibility of frequent treatment changes, complexity of treatments, being effective in the long-term, having difficulties regarding accessing and purchasing medicine, being more

**Table 3.** Comparison of the mean loneliness scores according to the various factors of patients

	Patients, n (%)	UCLA LS, (mean $\pm$ SD)	p	F
Family life	n = 325		0.018*	4.063
Patients who reported that their blood glucose levels were badly affected by their family life	76 (23.3)	43.78 $\pm$ 13.69		
Patients who reported that their blood glucose levels were not affected by their family life	104 (32)	38.53 $\pm$ 12.33		
Business life	n = 112		0.019*	4.194
Patients who reported that their blood glucose levels were badly affected by their business life	26 (23.2)	42.50 $\pm$ 14.51		
Patients who reported that their blood glucose levels were not affected by their business life	16 (14.2)	32.63 $\pm$ 9.26		
Diet therapy	n = 325		0.001*	7.752
Patients who reported that they had difficulties in adapting to diet therapy	78 (24)	45.53 $\pm$ 17.52		
Patients who reported that they had no difficulties in the diet adaptation process	100 (30.7)	37.76 $\pm$ 11.23		
Exercise therapy	n = 325		<0.001*	12.640
Patients who reported that they had difficulties in adapting to exercise therapy	148 (45.5)	44.97 $\pm$ 14.95		
Patients who reported that they had no difficulties in the exercise adaptation process	71 (21.8)	35.70 $\pm$ 10.13		
Medication adherence (diet and exercise therapy)	n = 325		0.021*	3.927
Patients who reported that they had difficulties in medication adherence	22 (6.7)	47.68 $\pm$ 18.33		
Patients who reported that they had no difficulties in medication adherence	213 (65.5)	40.27 $\pm$ 12.96		

F, one-way analysis of variance; \*p < 0.05.

UCLA LS, University of California, Los Angeles Loneliness Scale; SD, standard deviation.

**Table 4.** Correlations between loneliness and age, HbA1c levels, BMI, and fasting and postprandial blood glucose levels (n = 325)

	UCLA LS score	
	r	P
Age	-0.068	0.222
HbA1c	0.102	0.088
BMI	-0.006	0.944
Fasting blood glucose	0.032	0.569
Postprandial blood glucose	0.147	0.01 *

r, Pearson correlation coefficient; \*p < 0.05.

HbA1c, haemoglobin A1c; BMI, body mass index; UCLA LS, University of California, Los Angeles Loneliness Scale.

careful about food, and the requirement to have a more physically active life. Other factors include misconceptions with regard to the disease and medication, treatment approaches that may cause social divergence, communication problems with healthcare providers, a low level of literacy, and the absence of family and social support. This period, in which patients question themselves, has an increase in emotional difficulties and anxiety. Therefore, the possibility of experiencing psychosocial adaptation problems in patients with DM is a predictable condition.

DM affects all family members, with domestic relationships and quality of life affected by issues, such as changes in lifestyle, changed roles at home, and adaptation to difficulties that develop because of DM.<sup>6</sup> Previous studies have shown that older sufferers of DM can come into conflict with family members related to their diet and changes in eating and drinking habits.<sup>6,7</sup> Healthcare providers should talk to the family members of the individual with DM and encourage them to support the patient, which is a major part of general care and management.<sup>13</sup>

Women may be more sensitive to the stress of social relationships compared with men. However, no significant relationship

has been found between sex and loneliness scores in studies performed on different patient groups with different chronic diseases.<sup>19-22</sup> In the current study, loneliness scores tended to be higher in women than in men, but this difference was not significant. The score of loneliness in women might be higher because of their greater sensitivity to stress.

Previous studies have shown the protective effects of marriage on glycaemic control, particularly in men,<sup>23,24</sup> and a relationship has been found between being married and low distress related to DM.<sup>18</sup> An increase in the negative or positive qualities of a marriage may also decrease the prevalence of DM in women and men.<sup>25,26</sup> Other studies have identified a correlation between marital status and HbA1c levels, but no such correlation was found in others.<sup>11,12,27-32</sup> The loneliness scores of patients with similar chronic diseases (e.g., tuberculosis, cancer, and patients on haemodialysis) are significantly lower in married individuals than in unmarried individuals.<sup>19-22</sup> In the present study, consistent with previous studies<sup>19-22</sup>, the loneliness scores of married patients were low. We believe that a positive marriage and sharing in married individuals decrease levels of loneliness. Therefore, these patients are able to be more successful during the challenging long-term treatment and follow-up period of DM.

In several studies on loneliness in patients with cancer and tuberculosis, and in patients on haemodialysis, no significant differences were observed between educational and employment status and loneliness scores.<sup>19-22</sup> However, loneliness scores in these studies were significantly lower in patients who were high school graduates, in those who had a higher education, and in those who were employed. In the current study, loneliness levels were low in individuals who were high school graduates, in those who had a higher educational status, and in those who were employed. These findings may be attributed



**Table 5.** Descriptive statistics and comparison of the results for the total UCLA LS scores, and the relationship between loneliness scores and the patients' responses

	I would be very happy		I would be moderately happy		I do not feel anything		I would feel uncomfortable							
	Mean ± SD	F/p	Mean ± SD	F/p	Mean ± SD	F/p	Mean ± SD	F/p						
Age (years)														
18-39	36.55 ± 7.24	0.571	0.567	46.40 ± 11.81	8.868	0.01*	45.86 ± 10.54	1.880	0.165	55.27 ± 16.53	3.324	0.041*	6.707	0.001*
40-59	39.66 ± 11.99			35.74 ± 9.26			38.74 ± 14.39			45.68 ± 15.22			4.323	0.006*
≥ 60	37.97 ± 12.09			44.12 ± 12.66			48.00 ± 18.08			41.57 ± 14.41			2.108	0.104
Sex														
Women	38.69 ± 12.33	0.068	0.795	43.56 ± 12.71	6.886	0.01*	46.15 ± 15.82	7.750	0.008*	44.31 ± 13.57	0.409	0.525	2.631	0.05*
Men	38.11 ± 9.90			37.16 ± 9.55			33.43 ± 9.73			46.52 ± 17.25			6.141	0.001*
Marital status														
Married	38.23 ± 11.24	0.477	0.491	39.70 ± 11.72	6.801	0.011*	39.72 ± 12.87	9.374	0.004*	44.69 ± 14.84	1.408	0.239	3.831	0.01*
Not married	41.50 ± 11.61			49.00 ± 10.00			57.43 ± 20.44			50.90 ± 19.83			1.110	0.360

F, one-way analysis of variance; \*p < 0.05.

The final column of F/p values shows comparison of the ratios in each row.

UCLA LS, University of California, Los Angeles Loneliness Scale; SD, standard deviation.

to the fact that patients feel less lonely when they become more active in work and social life as their level of education increases, and they find regular employment.

Patients with type 1 DM are especially more prone to diabetes-associated distress and emotional distress. Revising these patients' care and support programs while taking into account this fact is important. In line with previous studies, the loneliness scores in the present study were significantly higher in patients with type 1 DM.<sup>14,15</sup> This is because patients with type 1 DM may feel more loneliness because they are under an increased level of stress owing to the challenging treatment regimens and the higher risk of acute complications, such as hypoglycaemia or hyperglycaemia coma. Moreover, the elevated level of loneliness among these individuals may be detrimental to their willingness and motivation to comply with the treatment, resulting in a poor prognosis. Therefore, we believe that physicians and other healthcare providers should monitor the level of loneliness in such patients during daily clinical practice. Additionally, preventive measures should be taken and the importance of the topic should be explained to the patients and their relatives.

In our study, when the relationship between DM complications and loneliness was examined, loneliness scores were significantly higher in patients with diabetic foot syndrome compared with those with other complications. This may indirectly decrease the familial, work, and social relations of the patient as a result of physiological and physical distress. Additionally, decreased compliance to DM treatment in patients who experience a high level of loneliness may also increase the risk of diabetic foot syndrome and other diabetes-related complications. Physicians and other healthcare providers should keep this possibility in mind, allowing them to be more proactive in preventing complications.

In the present study, the loneliness scores of patients who exercised regularly were significantly lower than those who did not. Furthermore, loneliness scores of patients who stated that they had difficulties in adapting to diet, exercise, or medication therapies were significantly higher than those of patients who did not. Compliance with diet, as well as exercise and treatment regimens, were better in patients with lower loneliness scores. This important finding highlights the relationship between loneliness and treatment compliance.

Notably, loneliness scores were elevated in patients who reported feeling discomfort or not feeling anything after being reminded by their spouses or family members to take their medications or follow their diet and exercise regimens. Consequently, we believe that the treatment process may be positively affected by evaluation of the patients' loneliness level, considering their feelings about being reminded to take their medication. To the best of our knowledge, no previous research has investigated this issue that was addressed in the current study. Overprotective or controlling family members could lead to the patient eating more or less, which may lead to hyperglycaemia or hypoglycaemic attacks, and may cause the individual to blame his/her family for the difficult experience that he/she is experiencing. Family members should be informed of the potential reactions of patients and should be advised to help them to adapt to changing living conditions. Communication-based family interviews should be conducted with the individual and the family members separately, as a beneficial approach to adaptation and meeting the patients' needs.

Our study has several implications. To the best of our knowledge, this is the first study, which was conducted in Turkey, to perform a detailed evaluation of the level of loneliness and treatment compliance among patients with DM. This study also provides

important insight into the relationship between patients' feelings at being reminded to take their medications and their level of loneliness. High loneliness scores may have a negative effect on the outcomes of diabetes. Loneliness may occur as a result of the long-term and challenging treatment process and potential complications related to DM, and the negative effect on the patient's compliance with treatment.

## Limitations

This study has some limitations, one of which is related to the absence of cognitive evaluation of the patients included in this study. There was no access to data regarding the history of mental disorders in the patient group as long as they were able to speak and understand our questions. Additional studies to evaluate the cognitive status of patients may be required to further clarify this topic.

Another limitation of this study is that none of the respondents was living alone. This may be attributed to the strong family bonds in the Turkish population because families and society support individuals with chronic diseases, such as not letting patients with DM live alone.

Another limitation is that there are no data from the literature to compare some of the current findings. Therefore, findings in this study should be considered as preliminary and further studies should be conducted to confirm the present study's results.

In conclusion, this study shows that patients with DM suffer from moderate and severe levels of loneliness. Loneliness scores are significantly elevated in individuals with a low level of education, unmarried individuals, students, patients diagnosed with type 1 DM, patients on insulin therapy, patients diagnosed with diabetic foot syndrome, patients who do not regularly exercise, and those who report being disturbed by reminders by their families or

spouses to take their medications or those who do not feel anything after such warnings. Healthcare providers and policymakers should develop training programs to reduce loneliness because this may potentially delay or prevent DM, reduce complications, and improve the health outcomes of patients who are exposed to these chronic conditions.

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## Declaration of conflicting interest

The author declare that there is no conflict of interest.

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