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Research Article

THE EFFECTS OF THE ANXIETY LEVELS OF TYPE 2 DIABETES MELLITUS PATIENTS ON THEIR TREATMENT ADHERENCE IN THE COVID-19 PANDEMIC PERIOD

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Abstract: *This study was conducted to investigate the effects of the anxiety levels of Diabetes Mellitus (DM) patients on their treatment adherence in the COVID-19 pandemic period. The sample of this descriptive and cross-sectional study consisted of 313 DM patients who presented to the internal medicine outpatient clinic between 01.01.2021 and 01.06.2021. The data were collected using a Personal Information Form, the Coronavirus Anxiety Scale (CAS), and the Morisky Medication Adherence Scale (MMAS-8). Descriptive statistics, Mann-Whitney U test, Kruskal-Wallis test, and Spearman's correlation test were used to analyze the data. The mean CAS score of the DM patients was 7.89±3.87, while their mean total MMAS-8 score was 4.06±1.56. It was determined that the patients who were using oral antidiabetic medications, those adhering to their medication and diet treatment, and those who were not COVID-19 had higher levels of anxiety. There was a negative significant relationship between the MMAS-8 and CAS scores of the patients ($p<0.05$). It was determined that as the anxiety levels of the DM patients increased in the pandemic process, their treatment adherence levels decreased. To reduce the anxiety levels and increase the treatment adherence of DM patients during the COVID-19 pandemic period, sufficient information, psychosocial support, and a multidisciplinary approach should be provided.*

Keywords*: COVID-19, Anxiety, Diabetes Mellitus, Type 2, Treatment Adherence.*

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1. Introduction

The Coronavirus Disease-2019 (COVID-19) was declared an international public health emergency and a pandemic on 11 March 2020 by the World Health Organization as it spreads rapidly from person to person and has high mortality rates [1]. According to the daily reports of the Turkish Ministry of Health, the total numbers of deaths due to COVID-19 per day are 1,275 in Turkey and 81,258 in the world [2]. It has been emphasized that the virus causing COVID-19 (SARS-CoV-2) continues to show its effects by mutating significantly affects the health of individuals with chronic diseases such as Diabetes Mellitus (DM) [3-6]. In Turkey, the COVID-19-related mortality rate of hospitalized diabetic patients was reported as 13.6% [2]. In studies conducted with DM patients with COVID-19, it has been reported that a comorbid disease like DM may require intensive care treatment, and it increases the risk of death [7, 8]. According to the International Diabetes Federation (IDF), among chronic diseases that are considered the greatest global health problem of the twenty-first century, DM

is a significant one with high treatment costs, morbidity rates, and mortality rates. According to the IDF data, one in every 10 people are diabetic, there are 537,000,000 diabetes patients in the world, and there are 9,020,900 such patients in Turkey [9]. DM was reported as the second-most frequently encountered condition in COVID-19 patients (IDF, 2020) and major comorbidity of COVID-19 infection [3].

Acute complications caused by DM include diabetic ketoacidosis, hyperglycemic hyperosmolar non-ketotic coma (HHNC), and hypoglycemia. Its chronic complications include microvascular complications such as diabetic retinopathy, nephropathy, and neuropathy, as well as macrovascular complications such as cardiovascular diseases, cerebrovascular events, and coronary artery diseases [10-12]. It has been determined that while DM patients are dealing with these acute and chronic complications, issues like quarantine, isolation and social media news brought about by COVID-19 increase the anxiety, fear, concern and stress experienced by these patients. Unfortunately, the COVID-19 pandemic period has been a period where DM patients have had difficulties in accepting their disease, adhering to their treatment, and changing their lifestyles [13, 14]. Previous studies investigating the effects of COVID-19 in DM patients have reported that 20-40% of DM patients have depression, anxiety, stress, and eating disorders [5, 14]. It has also been stated that COVID-19 increases the disease burden in DM patients [11], more than half of patients experience high levels of anxiety [15, 16], they have long-term permanent symptoms due to COVID-19 (chest pain, shortness of breath, cough, fatigue, loss of appetite, burnout, neurocognitive dysfunctions), and they have difficulty in managing their disease [3]. In the management of diabetes, one of the important issues is the management of diabetes treatment. The main elements of diabetes treatment management include medication, diet, exercise, personal management education, and self-check [17]. Medication adherence requires individual behaviors (e.g., taking one's medication, adhering to diet, making lifestyle changes) and taking general health precautions. Studies in the literature have shown that DM patients often do not adhere to their treatment [18-21]. It has been found that anxiety and depression affect the medication, diet and daily living activities of DM patients, and the frequency of their complications and their mortality rates have increased in the COVID-19 pandemic period [4, 7, 8, 22-24]. Restrictions caused by the pandemic period, stress, and experiencing moods such as fears, concerns or anxiety about death lead diabetic patients to experience more anxiety, prevent them from utilizing hospital services as much as they need to and interrupt their treatments [5, 13,15, 22].

This study was conducted to determine the effects of the COVID-19-related anxiety levels of DM patients on their treatment adherence in the COVID-19 pandemic period.

The research questions were as follows:

1. What are the anxiety levels of DM patients in the COVID-19 pandemic period?
2. What are the treatment adherence levels of DM patients in the COVID-19 pandemic period?
3. Do the sociodemographic and disease-related characteristics of diabetic patients affect their anxiety and treatment adherence in the COVID-19 pandemic period?
4. Is there a relationship between the anxiety levels and treatment adherence levels of DM patients in the COVID-19 pandemic period?

2. Material and Methods

2.1. Study Design

A descriptive and cross-sectional design was used in this study.

2.2. Setting and Sample

The population of this study consisted of DM patients presenting to the internal medicine outpatient clinic of the Ilgın State Hospital between 01.01.2021 and 01.06.2021. To determine the

sample size required for this study, the 1528 patient records at the DM outpatient clinic for the six previous months were taken as a basis and based on the formula for a known population, the minimum required sample size was calculated as 307 in a 95% confidence interval and with an error margin of 5%. The sample consisted of 313 patients who met the following inclusion criteria of the study: (a) Being 18 years old or older, (b) having been monitored with the diagnosis of DM for the least one year, (c) being a patient followed for at least 3 months (d) using at least 1 oral antidiabetic/insulin, (e) being literate, (f) being able to communicate, (g) not having a psychiatric problem (patients who were found to have no psychiatric problems in the patient file and verbally declared that they did not have any psychiatric disease), (h) and agreeing to participate in the study. Among the exclusion criteria of the study; (a) it including being under the age of 18, (b) filling in the forms incompletely, (c) having a psychiatric problem, (d) not volunteering to participate in the study.

2.3. Data Collection Instruments

The data were collected using a Personal Information Form, the Coronavirus Anxiety Scale (CAS), and the Morisky Medication Adherence Scale (MMAS-8).

2.3.1 Personal Information Form

The data collection form, which was prepared based on the literature [6,17, 21, 25-27], had a total of 25 questions including 12 questions on the sociodemographic characteristics of the participants (age, sex, education status, marital status, status of having children, income status, place of residence, disease duration, comorbidities, habits), 4 questions about the COVID-19 pandemic period (COVID-19 contact/positivity status, status of attending follow-ups in the COVID-19 pandemic period, blood sugar levels in the COVID-19 pandemic period), and 9 questions about DM and its treatment.

2.3.2 Coronavirus (COVID-19) Anxiety Scale (CAS)

CAS is a 5-point Likert-type scale that was developed by Lee et al. [28] It has 5 items and one dimension. Each item is scored based on the response options of "0" not at all, "1" rare, less than a day or two, "2" several days, "3" more than 7 days, and "4" nearly every day over the last 2 weeks. The validity and reliability study of the scale in Turkish was conducted by Biçer et al. [29]. The minimum and maximum scores of the scale are 0 and 20. Scores of 9 or higher indicate high levels of anxiety. While Biçer et al. [29] reported the Cronbach's alpha coefficient of the scale as 0.83, in this study, this coefficient was found as 0.73.

2.3.3 Morisky Medication Adherence Scale (MMAS-8)

MMAS-8 was tested for validity and reliability by Morisky. A revision was made to increase the validity and reliability of the scale, and the number of items was increased to 8 [30]. In Turkey, the validity and reliability study of the scale was carried out by Sayıner [31]. In the scale, 7 items are in the form of closed-ended questions with two options (yes/no), while one item is in the form of a closed-ended question with 5 options.

Positive responses to the items that are about concepts that would affect treatment adherence positively are marked as 1 point, while negative responses are marked as 0 points. A response of "no" to items 1, 2, 3, 4, 6 and 7 is marked as 1 point, while a response of "yes" to item 5 is marked as 1 point. Item 8 has multiple options, where only one response option (never/rarely) indicating high medication adherence is scored as 1 point when marked, and all other options that indicate low medication adherence are scored as 0 points. A score of 8 shows high adherence, a score of 6-7 shows medium adherence, and a score lower than 6 shows low adherence. The Cronbach's alpha coefficient of the scale was reported as 0.78, while in this study, the Cronbach's alpha coefficient was found as 0.72.

2.4. Data Collection

The data were collected face-to-face by using protective equipment and complying with the 1.5-meter distancing rule due to the ongoing COVID-19 pandemic. DM patients were informed by the researchers about the objective, process and data collection instruments of the study. They were informed that participation was voluntary, and they provided consent. It took each participant about 10-15 minutes to complete the data collection forms.

2.5. Ethical Statement

Ethics committee approval was gained from the Ethics Committee for Non-Interventional Clinical Studies at Selcuk University (Decision Number:2020/25) and the Scientific Research Platform of the Ministry of Health (Protocol number: 2020-12-08T11_10_22).

2.6. Data Analysis

The data were analyzed using the SPSS 24.0 (Statistical Package for the Social Sciences) software. The descriptive statistics of the data were calculated, and the Kolmogorov-Smirnov test was used to test normal distribution. The Cronbach's alpha coefficient was calculated as a measure of reliability. For the non-normally distributed variables, the Mann-Whitney U test was used in the comparison of two independent groups, whereas Kruskal-Wallis and Bonferroni tests were conducted to compare more than two groups. Spearman's correlation test was used to test correlations. The level of statistical significance for the statistical analyses was accepted as $p<0.05$.

3. Results

It was determined that 54.3% of the participants were in the age group of 36-64, 60.4% were women, 80.5% were married, 48.9% were working at a job, 52.1% had a medium level of income, 68.1% were living in districts, and 40.3% were primary-secondary school graduates (Table 1).

The participants who were 65 years old or older, those who had higher education degrees, those who were single, those who were not working, those with a good income level and those living in cities had significantly higher mean MMAS-8 scores ($p<0.05$) (Table 1). No significant relationship was found between the sociodemographic characteristics of the participants and their mean CAS scores ($p>0.05$) (Table 1).

Table 1. Distributions of the mean CAS and MMAS-8 Scores of the Type 2 DM Patients Based on their Sociodemographic Characteristics (n=313)

Sociodemographic Characteristics	**n**	**%**	**CAS** $\bar{X}$ **± SD**	**MMAS-8** $\bar{X}$ **± SD**
Age[2]				
18-35 years	4	1.3	9.25±2.62	3.33±1.15[a]
36-64 years	170	54.3	7.84±3.63	3.69±1.28[b]
65 years or older	139	44.4	7.92±4.17	4.80±1.54[c]
χ^2/p			χ^2=0.946, p=0.623	χ^2=29.722, p=0.000**, c>b>a
Sex[1]				
Female	189	60.4	8.04±3.72	4.32±1.52
Male	124	39.6	7.66±4.08	4.31±1.55
z/p			z=-1.137, p=0.256	z=-0.714, p=0.475

Table 1. continued.

Sociodemographic Characteristics	**n**	**%**	**CAS** $\bar{X} \pm SD$	**MMAS-8** $\bar{X} \pm SD$
Education Status[2]				
Illiterate	42	13.4	7.76±4.81	3.37±1.25[a]
Primary-secondary school	126	40.3	7.86±3.58	4.01±1.43[b]
High school	118	37.7	8.00±3.86	4.49±1.59[c]
Higher education	27	8.6	7.44+3.70	4.97±1.44[d]
χ^2/p			χ^2=1.197/ p=0.754	χ^2=28.573 p=0.000**, d>c>b>a
Marital Status[1]				
Married	252	80.5	7.79±3.61	4.08±1.50
Single	61	19.5	8.31±4.78	5.02±1.42
z/p			z=-0.403/ p=0.687	z=-4.442/ p=0.000**
Working Status[2]				
Housewife	149	47.6	8.06±3.81	4.21±1.57[a]
Working	153	48.9	8.69±3.89	3.88±1.52[b]
Not working	11	3.5	8.01±3.17	4.40±1.71[c]
χ^2/p			χ^2=0.213/p=0.418	χ^2=22.493/ p=0.000**, c>a>b
Income Status[2]				
Good	119	38.0	8.49±3.82	4.60±1.51[a]
Medium	163	52.1	7.54±3.96	4.25±1.48[b]
Bad	31	9.9	7.45±3.34	3.96±1.53[c]
χ^2/p			χ^2=4.727/p=0.094	χ^2=10.630/ p=0.005*, a>b>c
Place of Residence[2]				
City				
District	19	6.0	6.47±2.48	4.92±1.52[a]
Town/village	213	68.1	8.04±4.00	4.02±1.45[b]
	81	25.9	7.83±3.74	4.33±1.80[c]
χ^2/p			χ^2=2.572/p=0.276	χ^2=23.188/ p=0.000**, a>c>b

[1]Two non-normally distributed independent groups were compared using Z: Mann-Whitney U Test [2]Three non-normally distributed independent groups were compared using X^2: Kruskal-Wallis Test, CAS: Coronavirus (COVID-19) Anxiety Scale, MMAS-8: Morisky Medication Adherence Scale; *:p<0.05; **:p<0.01

As seen in Table 2, 45.0% of the participants had a disease duration of 1-10 years, the treatment modality of 53.0% consisted of diet, oral antidiabetics and insulin treatment, 36.4% had been using oral antidiabetic medications for 11-20 years, and 38.6% had been using insulin for 6-10 years. DM-related complications developed in 36.4% of the participants, 62.9% attended health follow-ups regularly, 87.2% adhered to their medication treatment, and 68.1% did not adhere to their diet treatment. It was found that the COVID-19 pandemic prevented 82.4% of the participants from attending their health follow-ups, and the blood sugar levels of 59.1% were affected due to the COVID-19 pandemic. It was learned that 48.6% of the participants had been COVID-19 positive, and 66.5% had been in contact with a COVID-19 patient (Table 2).

The participants whose disease duration was 31-40 years, those whose treatment modality involved diet, oral antidiabetics and insulin, those whose oral antidiabetic medication use duration was 31-40 years, those with an insulin use duration of 21-30 years, those who had experienced DM-related complications, those who attended their health follow-ups regularly, those who adhered to their medication treatment, those who adhered to their diet treatment, those whose attendance to health follow-ups was not prevented due to COVID-19, those whose blood sugar levels were affected due to

COVID-19, and those who had been COVID-19-positive had significantly higher mean MMAS-8 scores ($p<0.05$) (Table 2). There was no significant difference in the mean MMAS-8 scores of the participants based on their COVID-19 contact status ($p>0.05$) (Table 2).

The participants whose treatment modality included diet, oral antibiotics and insulin, those who adhered to their medication and diet treatment, and those who had not been COVID-19 positive had significantly higher mean CAS scores ($p<0.05$). No significant relationship was found between the other disease-related characteristics of the participants and their mean CAS scores (Table 2).

Table 2. Distributions of the mean CAS and MMAS-8 Scores of the Type 2 DM Patients Based on their Sociodemographic Characteristics (n=313)

Sociodemographic Characteristics	**n**	**%**	**CAS X±SD**	**MMAS-8 X±SD**
DM disease duration[2]				
1-10 years	141	45.0	7.58±3.57	3.79±1.46[a]
11-20 years	116	37.1	7.91±3.90	4.00±1.56[b]
21-30 years	42	13.4	8.85±4.39	4.73±1.46[c]
31-40 years	14	4.5	8.00±4.67	5.14±1.83[d]
χ^2/p			χ^2=2.298, p=0.513	χ^2=18.397, p=0.000**, d>c>b>a
DM treatment modality[2]				
Oral antidiabetic	3	1.0	10.33±5.85[a]	4.00±1.73[a]
Diet and oral antidiabetic	144	46.0	7.22±3.63[b]	3.76±1.54[b]
Diet, oral antidiabetic and insulin	166	53.0	8.43±3.96[c]	4.31±1.53[c]
χ^2/p			χ^2=7.480, p=0.024*, a>c>b	χ^2=11.715, p=0.003*, c>a>b
Duration of oral antidiabetic use[2]				
1-5 years	6	17.9	7.75±3.41	3.78±1.38[a]
6-10 years	7	27.8	7.66±3.85	3.81±1.52[b]
11-20 years	14	36.4	7.78±3.79	4.00±1.56[c]
21-30 years	3	13.7	8.93±4.37	4.79±1.48[d]
31-40 years	3	4.2	7.69±4.71	5.00±1.82[e]
χ^2/p			χ^2=0.541, p=0.627	χ^2=9.985 , p=0.001**, e>d>c>b>a
Duration of insulin use[2]				
1-5 years	3	19.9	8.84±4.06	3.96±1.35[a]
6-10 years	4	38.6	8.46±3.79	4.21±1.46[b]
11-20 years	5	33.1	8.20±3.63	4.32±1.59[c]
21-30 years	4	8.4	8.28±5.75	5.57±1.55[d]
χ^2/p			χ^2=, p=0.910	χ^2=, p=0.019* , d>c>b>a
Has developed DM-related complications[1]				
Yes	114	36.4	8.07±4.48	4.68±1.57
No	199	63.6	7.79±3.48	3.70±1.44
z/p			z=-0.001, p=0.999	z=-5.364, p=0.000**
Attends follow-ups regularly[1]				
Yes	197	62.9	7.41±4.03	5.05±1.57
No	116	37.1	8.18±3.75	3.47±1.22
z/p			z=-1.752, p=0.080	z=-8.394, p=0.000**

Table 2. Continued.

Sociodemographic Characteristics	n	%	CAS X±SD	MMAS-8 X±SD
Adheres to medication treatment[1]				
Yes	273	87.2	8.09±3.83	5.97±1.36
No	40	12.8	6.55±3.91	3.78±1.38
z/p			z=-2.136, p=0.033*	z=-7.498, p=0.000**
Adheres to diet treatment[1]				
Yes	100	31.9	8.64±3.83	4.53±1.55
No	213	68.1	7.54±3.84	3.05±0.97
			z=-2.528, p=0.011*	z=-8.221, p=0.000**
COVID-19 pandemic prevented attendance to follow-ups[1]				
Yes	258	82.4	7.96±3.80	4.20±1.45
No	55	17.6	4.67±1.84	4.83±1.80
z/p			z=-0.819, p=0.413	z=-2.615, p=0.009**
COVID-19 pandemic affected blood sugar levels[1]				
Yes	185	59.1	8.01±3.89	4.79±1.43
No	128	40.9	7.81±3.86	3.43±1.32
z/p			z=-2.136 , p=0.569	z=-7.498, p=0.000**
Has been COVID-19-positive[1]				
Yes	152	48.6	7.38±3.56	4.50±1.45
No	161	51.4	8.38±4.08	4.12±1.60
z/p			z=-2.110, p=0.035*	z=-2.412, p=0.016*
Has had contact with a COVID-19 patient[1]				
Yes	208	66.5	7.68±4.01	4.43±1.47
No	105	33.5	8.31±3.54	4.10±1.64
z/p			z=-1.637, p=0.102	z=-1.856, p=0.063

Min: Minimum, **Max:** Maximum, CAS: Coronavirus (COVID-19) Anxiety Scale, MMAS-8: Morisky Medication Adherence Scale, [1]Two non-normally distributed independent groups were compared using Z: Mann-Whitney U Test, [2]Three non-normally distributed independent groups were compared using X^2: Kruskal-Wallis Test; *:p<0.05; **:p<0.01

As seen in Table 3, the mean CAS and MMAS-8 scores of the participants were 7.89±3.87 and 4.06±1.56, respectively. In our study, the treatment adherence levels of 77.3% of the participants were low with a mean score of 3.35±0.92, while the treatment adherence levels of 22.7% were moderate with a mean score of 6.47±0.50 (Table 3).

Table 3. Mean CAS and MMAS-8 Scores of the Type 2 Diabetes Patients (n=313)

	n	%	X̄±SD	Min	Max	Cronbach's alpha
Mean CAS score (Min: 0, Max: 20)	313	100.0	7.89±3.87	0.0	20.0	0.73
Mean MMAS-8 score of all patients (Min: 0, Max: 8)	313	100.0	4.06±1.56	1.0	7	0.72
Patients with low adherence, <6	242	77.3	3.35±0.92	1	5	
Patients with medium adherence, 6-7 71 22.7	71	22.7	6.47±0.50	6	7	

Min: Minimum, Max: Maximum, X̄: Arithmetic mean, SD: Standard deviation, CAS: Coronavirus (COVID-19) Anxiety Scale, MMAS-8: Morisky Medication Adherence Scale

According to the sociodemographic characteristics and mean treatment adherence levels of the participants shown in Table 4, the treatment adherence levels of the participants had weak positive relationships to their age and place of residence, a weak negative relationship to their education status (p=0.000), and a very weak positive relationship to their income status (p<0.05) (Table 4). Moreover, the treatment adherence levels of the participants had weak positive relationships with their disease durations and their durations of oral antidiabetic medication use, very weak positive relationships to their treatment modality and duration of insulin use, and a very weak negative relationship to their status of having experienced DM-related complications (p<0.05). The status of the participants to consider COVID-19 as an obstacle to treatment management was weakly and negatively associated with their treatment adherence levels (p=0.016), while there was a very weak negative relationship between their mean CAS and MMAS-8 scores (p=0.036) (Table 4).

Table 4. Correlations between the Mean CAS and MMAS-8 Scores of the Type 2 DM Patients

Patient Characteristics	MMAS-8	
	r	p
Age	0.305	0.000**
Education status	-0.285	0.000**
Income status	0.150	0.008**
Place of residence	0.233	0.000**
DM disease duration	0.231	0.000**
DM treatment modality	0.192	0.001**
Oral antidiabetic medication use duration	0.223	0.000**
Insulin use duration	0.166	0.033*
Status of having experienced DM-related complications	-0.304	0.000**
Prevention of treatment management due to COVID-19	0.148	0.009**
Status of having been COVID-19-positive	-0.137	0.016*
CAS	-0.119	0.036*

*Spearman's Correlation, DM: Diabetes Mellitus, CAS: Coronavirus (COVID-19) Anxiety Scale, MMAS-8: Morisky Medication Adherence Scale; *:p<0.05; **:p<0.01

4. Discussion

The COVID-19 pandemic not only continues to show its effects worldwide but also increases the hospitalization rates of especially individuals with chronic diseases like DM and leads them to experience death anxiety, fear, and concerns [7, 8, 14, 32, 33]. Studies conducted with COVID-19 patients have reported the prevalence of DM in these patients in the range of 5-36% [8,34,35]. It has been stated that the COVID-19 pandemic increases the anxiety levels and complication frequencies of DM patients with multiple psychosocial problems and affects their treatment adherence negatively [23, 32, 36, 37]. In the COVID-19 pandemic period, significant factors associated with anxiety and treatment adherence in Type 2 DM patients include worsened glycemic control, quarantine measures, inability to find medications, the inadequacy of vaccines, catching COVID-19, and fear of death. Therefore, the effects of the anxiety created by the COVID-19 pandemic in the treatment and disease processes of Type 2 DM patients on their DM treatment adherence are discussed here along with the reports of other studies in the literature.

In our study, the mean Coronavirus Anxiety Scale (CAS) score of the Type 2 DM patients was found as 7.89±3.87. Şişman et al. reported the mean anxiety score of DM patients as 7.5±4.3 [15]. Singhai et al. stated that DM patients experienced anxiety in the management of their treatment processes when they were infected with COVID-19 due to their infection status and the portrayal of diabetic individuals as a risk group on the media [32]. Bozkurt et al., (2021), in their study in which they investigated the perceived stress level and health anxiety in patients with diabetes mellitus and hypertension during the COVID-19 pandemic, had similar results with our study findings. Patients had higher levels of anxiety, depression and health anxiety compared to healthy individuals [38]. Unfortunately, the pandemic process increases the stress, anxiety and fears of patients and leads to negative health behaviors [13, 15, 39]. Considering that the numbers of cases and mortalities in the COVID-19 pandemic period are increasing day by day, preventing DM patients from experiencing high levels of anxiety, fear and stress will distract them from having thoughts about their possibility of dying. It is thought that it is important to support the management of anxiety and stress in DM patients in the pandemic period and provide a holistic approach by establishing multidisciplinary clinics that offer treatment management for DM patients.

In this study, the mean MMAS-8 score of all participants was found as 4.06±1.56, which indicated low treatment adherence levels in general. The increased probability of getting infected at hospitals due to the COVID-19 pandemic has prevented many patients from entering hospital environments for their follow-ups and treatments [13]. Studies in the literature that have been conducted with DM patients in the COVID-19 pandemic period have stated that the medication and treatment adherence levels of patients have been disrupted, their glycemic indices have worsened, and this situation would increase the disease burden of DM [4, 23, 36, 40,41]. It is considered that if DM patients have low levels of treatment adherence, they will not be able to obtain the optimal benefits expected from diets and medications. According to these results, it is seen as an important issue in the COVID-19 pandemic period to alleviate the anxieties of DM patients and increase their treatment adherence in terms of preventing complications and reducing their mortality rates.

In our study, it was determined that 87.2% of the participants adhered to their medication treatment, but 68.1% did not adhere to their diet treatment, and the COVID-19 prevented 82.4% of the participants from attending their follow-ups. It was found that the mean MMAS-8 scores of those who adhered to their medication and diet treatments were higher. While 59.1% of the participants stated that the COVID-19 pandemic affected their blood sugar levels, those who reported such an effect had a higher mean MMAS-8 score (Table 2). It has been seen in the literature that similar results to those in our study have been reported, the vast majority of patients have difficulty in keeping their blood sugar

levels under control [42], and they experience deterioration in their glycemic control (high fasting blood sugar) [43]. Additionally, it has been emphasized that although individuals state that they adhere to their diet treatments in the pandemic period, they have difficulty in this matter, and their diet treatment adherence rates are low [6, 42, 44]. In DM, adherence to medication and diet treatments is an important issue in reducing their complications and mortalities and increasing their quality of life [42]. It was found in this study that the participants who attended their follow-ups regularly had higher treatment adherence levels. The low treatment adherence levels of the participants who did not attend their follow-ups regularly could be related to the possibility that most of these patients were afraid of going to the hospital during the pandemic period, they could not keep up with their new treatments and medications, their medications and treatment methods were affected, and they had difficulties in adjusting their medication doses. The higher treatment adherence levels of DM patients who attend their follow-ups regularly in comparison to those who do not is an expected result. As long as the pandemic period goes on, patients should be constantly informed about their regular attendance to follow-ups, as well as new developments in medications and treatments.

In this study, in the comparisons of the treatment adherence levels of the participants based on their sociodemographic characteristics, it was found that the participants who were 65 years old or older, those who had higher education degrees, those who were single, those who were not working, those who had good income levels, and those who were living in cities had higher treatment adherence levels ($p<0.05$) (Table 1). However, because MMAS-8 scores under 6 are interpreted as low adherence, the result in our study was not on the desired level. As the result in our study, some other studies in the literature have reported that sex, age and marital status are influential on treatment adherence [15, 41, 44]. These results led us to consider that as most patients in our study were middle-aged or older than 65 years old, they were afraid of getting infected with COVID-19, and their treatment adherence levels were better because of this. It was also considered that because the vast majority of the participants were women, married and housewives, they were unable to utilize diabetes education programs, their knowledge levels were low, this lowered their treatment adherence levels, and thus, the single participants showed better treatment adherence.

It was found in our study that the participants who did not develop complications due to DM had lower treatment adherence levels, and the COVID-19 pandemic prevented most participants from attending health follow-ups (Table 2). Similar results have been reported in the literature, and accordingly, the COVID-19 pandemic increases the stress and anxiety levels and complication rates of DM patients, and as a consequence, it affects treatment adherence negatively [23,32,36]. These results indicated that the participants who did not develop DM-related complications could have been less aware of the outcomes of such complications, or their awareness about complications might not have developed, and their treatment adherence levels were insufficient as a result. It is thought that the patients who had developed COVID-19 infection and those who had ongoing complications were afraid of the disease, infections in general, and death, and because of this, they tried to adhere to their treatment to avoid getting infected again.

In this study, the participants whose DM disease duration was 31-40 years, those whose insulin use duration was 21-30 years, and those whose oral antidiabetic medication use duration was 31-40 years had higher treatment adherence levels (Table 2). While some studies in the literature provided findings that were in agreement with our results [17, 45], there were other studies that did not support our results and stated that as the disease duration of DM patients increases, their treatment adherence decreases [25, 27, 46]. In light of these results, it may be thought that DM patients accept their disease and treatments better as their disease duration increases, they develop better-coping strategies throughout this process, and therefore, their treatment adherence levels increase.

The participants of our study who stated that they adhered to their medication and diet treatments had higher CAS scores. It was also observed that the participants who had been COVID-19-positive had higher anxiety levels than those who had not been COVID-19-positive (Table 2). Previous studies have found that in the COVID-19 pandemic period, DM patients have high levels of concern about getting the disease and getting sick, they are afraid of dying, and this situation could lead them to experience anxiety [16, 42]. Based on these results, it is believed that DM patients with high COVID-19-related anxiety levels show better adherence to their medication treatments. Although a substantial ratio of the world's population has been vaccinated, the pandemic still poses a great risk for individuals with chronic diseases like DM. Therefore, the necessary precautions should be taken to enable individuals with chronic diseases to attend their follow-ups regularly.

In our study, a negative significant relationship was identified between the mean CAS and MMAS-8 scores of the participants ($p<0.05$). Studies in the literature carried out with DM patients have provided similar results and revealed that the anxiety and stress levels of these patients are high, their eating behaviors are negative, and their blood sugar levels and body mass indices increase [15, 47].

5. Conclusions and recommendations

In our study, it was determined that as the anxiety levels of the Type 2 DM patients increased, their treatment adherence levels decreased. It is seen that although vaccination efforts are in place in the ongoing COVID-19 pandemic period, most individuals who have chronic diseases are afraid of going to the hospital, this may affect their treatment adherence negatively, and it is important to lower the anxiety levels and increase the treatment adherence levels of patients of chronic diseases in cases like epidemics and pandemics. As long as the COVID-19 pandemic continues, it is recommended to establish diabetes support desks at hospitals, family health centers and public health centers where healthcare services are provided to reduce the anxiety levels and increase the treatment adherence of DM patients, who are in the high-risk group, enabling follow up on patients online at home by activating telehealth services, and provide the necessary information and psychosocial support that will reduce the concerns of patients.

Limitations of the Research

The sample of this study consisted of DM patients visiting the internal medicine outpatient clinic of a State Hospital in Turkey, and the results do not represent all DM patients in Turkey. In addition, whether the patients have psychiatric disorders is limited to the patient file and patient statement. The difficulties in the low number of patients with DM coming to the outpatient clinic due to the COVID-19 pandemic and the difficulty of working in accordance with mask, distance and hygiene conditions can be counted among the limitations.

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Informed Consent

Informed consent was obtained from all individual participants included in the study.

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Ethical statement

Ethics committee approval was gained from the Ethics Committee for Non-Interventional Clinical Studies at Selcuk University (Decision Number:2020/25) and the Scientific Research Platform of the Ministry of Health (Protocol number: 2020-12-08T11_10_22).

Conflict of interest:

The authors declare that they have no confict of interest.

Authors' Contributions:
Concept – S.Ş., A.Y.K.; Design- S.Ş., A.Y.K; Supervision- S.Ş., A.Y.K; Resource- S.Ş., A.Y.K; Materials- S.Ş., A.Y.K; Data Collection and/orProcessing–S.Ş., A.Y.K., Z.B.T; Analysis and/or Interpretation- S.Ş., A.Y.K.; Literature Search– S.Ş., A.Y.K.; Writing– S.Ş., A.Y.K.; Critical Reviews– S.Ş., A.Y.K.; Other- S.Ş., A.Y.K.

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