Arch Health Sci Res. 2022;9(1):61-69
DOI: 10.5152/ArcHealthSciRes.2022.21088

Original Article

Investigation of the Perceived Stress Levels and Adherence to Treatment of Individuals with Type 2 Diabetes During the COVID-19 Pandemic

Zeliha BÜYÜKBAYRAM[1], Meyreme AKSOY[1], Abdurrahman GÜNGÖR[2]

[1]Department of Nursing, Siirt University, Faculty of Health Sciences, Siirt, Turkey
[2]Siirt Training and Research Hospital, Siirt, Turkey

Cite this article as: Büyükbayram Z, Aksoy M, Güngör A. Investigation of the perceived stress levels and adherence to treatment of individuals with type 2 diabetes during the COVID-19 pandemic. *Arch Health Sci Res.* 2022; 9(1): 61-69.

ABSTRACT

Objective: This research was conducted in a descriptive-relational type in order to examine the relationship between the investigation of the perceived stress levels and adherence to treatment of individuals with type 2 diabetes during the coronavirus disease-2019 pandemic.

Materials and Methods: The population of the study consisted of adult individuals diagnosed with diabetes for at least 1 year, who were admitted to the İnternal Medicine Clinic of a Training and Research Hospital located in the southeast of Turkey. The sample of the study consisted of 184 individuals with type 2 diabetes who accepted to participate in the study and met the research criteria. The data of the study were collected from the Patient Identification Form, the Perceived Stress Scale, and the Patient Adherence to Type 2 Diabetes Mellitus Treatment Scale forms. Descriptive statistics, independent groups *t*-test, one-way analysis of variance, Kruskal–Wallis, Dunn–Bonferroni test, and Pearson correlation analysis were used to evaluate the data.

Results: The mean total score of patient compliance in the treatment of perceived stress and type 2 diabetes was found to be 23.82 ± 8.34 and 99.69 ± 17.68, respectively. The difference between the overall total score averages of the patient adherence scale in the treatment of type 2 diabetes, according to the individual's state of having coronavirus disease 2019 and the disruption of controls during the pandemic process, and the total sub-dimension of perceived stress, and having coronavirus disease-2019 in the family was found to be statistically significant ($P < .05$). A weak negative correlation was found between perceived stress and mean scores of adherence to treatment ($P < .05$).

Conclusion: In the study, it was determined that individuals with diabetes had moderate levels of perceived stress and adherence to treatment and that as perceived stress levels increased, their level of adherence to treatment decreased.

Keywords: Adherence to treatment, pandemic, perceived stress, type 2 diabetes

Introduction

The coronavirus disease-2019 (COVID-19), which has caused millions of lives to be adversely affected and lost their lives, is a major health crisis and has a major impact on daily life around the world.[1] On March 11, 2020, the World Health Organization announced that COVID-19 caused 118 000 cases in 114 countries, 4291 people had died, and accordingly declared COVID-19 a pandemic.[2] Due to the fact that COVID-19 has not yet had a definitive treatment, it causes a rapid increase in morbidity and mortality rates.[1,3] More than 200 million cases of COVID-19 have been confirmed worldwide. In addition, the COVID-19 pandemic has caused the deaths of approximately 4.3 million people and continues to cause deaths worldwide.[2] As the number of cases increases, all countries have started to take numerous significant measures. After the first officially reported case in Turkey on March 11, 2020, schools and universities were closed on March 16, 2020. During March, many restrictions have been imposed throughout Turkey. In this process, clinical services have undergone changes, and as a result, like many chronic diseases, the treatment and follow-up of people with diabetes have been negatively affected.[3] It has been stated that the increased stress due to sudden and major disruptions due to the pandemic in daily life negatively affects the adherence to treatment of individuals with diabetes.[1,3]

The COVID-19 pandemic has a negative impact on individuals with chronic diseases, such as diabetes in particular.[4-6] Conditions such as changes in diet and exercise, difficulty obtaining medications, disruption in health care delivery and access, increased stress, and fear of being infected by the

Corresponding author: Zeliha BÜYÜKBAYRAM, e-mail: zeliha_bbayram@hotmail.com

Received: August 23, 2021
Accepted: October 25, 2021
Available Online Date: January 1, 2022

virus have negative effects.[4,7,8] These negative effects can affect the emotional state of the patients and their adherence to treatment, disrupting glycemic control, leading to an increase in obesity, and exacerbating the comorbidities associated with these problems.[8] In their study, Yan et al[9] stated that 48 out of 193 patients with COVID-19 (24.9%) had diabetes. All these changes lead to an increase in the stress level of people with diabetes and, accordingly, negatively affect their adherence to treatment.[8,10] Although the problem of adherence to treatment is common in individuals with diabetes, it was found that this problem increases more during the pandemic.[4,9] In individuals with diabetes, the inability to achieve adherence to treatment impedes the effectiveness of treatment, negatively affects the course of the disease, and with the addition of comorbidities, it is observed that it leads to an increase in health care costs and an increase in mortality rates.[11] In the literature review, a limited number of studies were found on the stress levels of individuals with type 2 diabetes during the pandemic and their adherence to treatment.[1,8] Therefore, it is important to evaluate the effect of the level of stress on adherence to treatment adaptation in individuals with diabetes mellitus. In accordance with this information, this study was conducted to investigate the stress levels perceived by individuals with type 2 diabetes during the COVID-19 pandemic and their adherence to treatment.

Materials and Methods

Research Design

The present study is descriptive, correlational type research.

Study Population and Sample

The study population consisted of individuals with diabetes who were admitted to an internal medicine clinic of a Training and Research Hospital located in the southeast of Turkey. The research sample consisted of 184 individuals with diabetes who met the research inclusion criteria, without any sampling selection, and who agreed to participate in the study. According to the research inclusion criteria, individuals over the age of 18 who have been diagnosed with type 2 diabetes for at least a year and who can communicate verbally were included in the study. Power analysis of the study was performed using the GPower 3.1 program. As a result of the power analysis, it was found that the sample was sufficient with an effect size of 0.212, a power of 90%, and a margin of error of 0.05.

Data Collection Instruments

The study data were collected using the "Patient Information Form," "Perceived Stress Scale (PSS-14)," and "Assessment Scale for Treatment Adherence in Type 2 Diabetes Mellitus."

The data were collected by the researchers using the face-to-face interview technique at the internal medicine clinic of Siirt Training and Research Hospital between January 2021 and July 2021. Each interview lasted for about 10-15 minutes.

Patient Information Form

Prepared by the researchers in accordance with the literature,[12-14] this questionnaire consists of a total of 11 items on age, gender, marital status, educational level, profession, the status of COVID-19 infection in themselves or in family members, another chronic disease status, the status of disruptions in their controls during the pandemic, duration of illness, and treatment.

Perceived Stress Scale

The Perceived Stress Scale (PSS-14), developed by Cohen et al.[15] consists of a total of 14 items. Turkish validity and reliability study was conducted by Eskin et al.[16] The items of the 5-point Likert-type scale ranges from "never (0)" to "very often (4)." Seven of the items with positive expressions (4, 5, 6, 7, 9, 10, and 13) are reverse-coded. There are 2 sub-scales of the scale: perceived insufficient self-efficacy (4, 5, 6, 8, 9, 10, and 13) and perceived stress/distress (1, 2, 3, 7, 11, 12, and 14). The scores that can be obtained from this scale range from 0 to 56. In the total scale score, 0-13 points indicate low-level stress, 14-27 points indicate moderate-level, 28-41 points indicate high-level, and 42-56 points indicate very high-level stress. The Cronbach's alpha coefficient of the scale was 0.84.[16] The Cronbach's alpha coefficient was calculated as 0.92 in this study.

Assessment Scale for Treatment Adherence in Type 2 Diabetes Mellitus

The scale has been developed by Demirtas et al[17] in order to measure adherence to treatment in individuals with type 2 diabetes. The 5-point Likert-type scale is used for measuring the scale items (1 = strongly agree, 2 = agree, 3 = neither agree nor disagree, 4 = disagree, 5 = strongly disagree). The scale consists of a total of 30 items and 7 sub-scales: attitudes and emotional factors (11,12,14,20,22,23,28,29), information and personal factors (3,7,8,13,16,26), lifestyle changes (5,19,27), the feelings of anger (10,18,21), emotions, and behaviors appropriate for adherence (1,15,17,25), diet negotiation (6,24,30), and denial (2,4,9) There are 13 positive items (1, 3, 5, 8, 13, 15, 16, 17, 19, 23, 25, 26, 29) and 17 negative items (2, 4, 6, 7, 9, 10, 11, 12, 14, 18, 20, 21, 22, 24, 27, 28, 30) on the scale. The scores can be obtained from this scale range from 30 to 150. In the interpretation of the scores, 30-54 points indicate a good level of adherence to treatment, 55-125 points indicate a moderate level of adherence to treatment, and 126-150 points indicate a poor level of adherence to treatment. Higher scores indicate non-adherence to treatment. The Cronbach's alpha coefficient of the scale was 0.77.[17] The Cronbach's alpha coefficient was calculated as 0.92 in this study.

Evaluation of the Data

The data were analyzed using Statistical Package for the Social Sciences 25.0 software. Shapiro–Wilk normality test and Q–Q graphs were used to evaluate the normal distribution. Descriptive statistics (mean, standard deviation, number, and percentages), *t*-test in independent groups, one-way analysis of variance, Kruskal–Wallis test, and Pearson analysis were used to evaluate the data. For the variables that were found to be important as a result of Kruskal–Wallis analysis, the Dunn–Bonferroni test was used for multiple comparisons between the categories. The statistical significance level of $P < .05$ was used.

Ethical Approval of the Study

Before starting the study, official written permission was obtained from the studied hospital, and ethical approval was obtained from the Siirt Non-Interventional Clinical Research Ethics Committee (Date: December 31, 2020, and Decision No:14178). Informed written and verbal consents were obtained from all the patients included in the research.

Results

In our study, the average age of the individuals with diabetes was 51.77 ± 15.07, 52.2% was female, 83.2% was married, 46.7% was illiterate, 37.0% was a housewife, 38.0% had the disease for 6-10 years, 50.0% was receiving insulin therapy, 66.3% had another chronic disease, 67.4% had COVID-19, 81.5% had family members who got COVID-19, 78.8% had his/her controls disrupted, 0.5% had "good" adherence to the treatment, 94.6% had "moderate" adherence to the treatment, and 4.9% had "poor" adherence to treatment (Table 1).

The perceived insufficient self-efficacy, perceived stress/distress sub-scales, and the PSS total score of the individuals with diabetes were found to be 11.79 ± 4.20, 12.02 ± 4.51, and 23.82 ± 8.34, respectively. The attitudes and emotional factors, awareness and personal factors, lifestyle changes, the feelings of anger, emotions and behaviors appropriate for adherence, diet negotiation, and denial sub-scale, and total scale scores of the Assessment Scale for Treatment Adherence in Type 2 Diabetes Mellitus were 26.37 ± 5.02, 20.02 ± 3.63, 9.92 ± 1.95, 9.70 ± 2.23, 13.74 ± 3.99, 10.12 ± 1.99, 9.79 ± 2.21, and 99.69 ± 17.68, respectively (Table 2).

It was found that the difference between the PSS perceived insufficient self-efficacy score averages was statistically significant in terms of the treatment of the disease in individuals with diabetes ($P < .05$). The difference between PSS total and perceived stress/distress sub-scale score averages was found to be statistically significant in terms of the status of getting infected with COVID-19 and disruptions of check-ups during the pandemic ($P < .05$). In the Dunn–Bonferroni multiple comparisons carried out to determine the originating group of the difference, it was found that there was a statistically significant difference between patients taking oral antidiabetics and insulin therapy and those taking insulin therapy had a higher insufficient perceived self-efficacy sub-scale score ($P < .05$) (Table 3).

Table 1. Distribution of Participants by Descriptive Characteristics (n = 184)

Features of the Participants	(N)	(%)
Gender		
Female	96	52.2
Male	88	47.8
Marital status		
Married	153	83.2
Single	31	16.8
Education level		
İlliterate	86	46.7
Literate	37	20.1
Primary school	39	21.2
High school and above	22	12.0
Occupation		
Unemployed	34	18.5
Worker	40	21.7
Civil servant	14	7.6
Housewife	68	37.0
Others	28	15.2
Duration of disease (years)		
1-5	48	26.1
6-10	70	38.0
11-15	38	20.7
16 and above	28	15.2
Treatment of the disease		
Insulin	92	50.0
Oral antidiabetic	43	23.4
Diet and oral antidiabetic	37	20.1
Diet only	12	6.5
Another chronic disease		
Yes	122	66.3
No	62	33.7
Passing COVID-19		
Yes	124	67.4
No	60	32.6
Passing COVID-19 in your family		
Yes	150	81.5
No	34	18.5
Disruption of controls during the pandemic process		
Yes	145	78.8
No	39	21.2
Adherence to the treatment *		
Good adherence to the treatment	1	0.5
Moderate adherence to the treatment	174	94.6
Poor adherence to the treatment	9	4.9
Mean age ($\bar{X} \pm SD$)	51.77 ± 15.07	

SD, standard deviation; $\bar{X}$, mean; min, minimum; max, maximum.
*Descriptive findings regarding the adherence to treatment scale.

A statistically significant difference was found between the lifestyle change sub-scale score averages of the Assessment Scale for Treatment Adherence in Type 2 Diabetes Mellitus according to the gender of the individuals with diabetes ($P < .05$). A statistically significant difference was found between the emotions and behaviors toward adherence sub-scale score averages of the Assessment Scale for Treatment Adherence in Type 2 Diabetes Mellitus according to the professions of the individuals ($P < .05$). It was found that there was a statistically significant difference between the anger feelings sub-scale and total score averages of the Assessment Scale for Treatment Adherence in Type 2 Diabetes Mellitus according to the presence of COVID-19 in the family members ($P < .05$). A statistically significant difference was found between the anger feelings sub-scale score averages of the Assessment Scale for Treatment Adherence in Type 2 Diabetes Mellitus according to the disease treatment ($P < .05$). A statistically significant difference was found between the attitude and emotional factors sub-scale score averages of the Assessment Scale for Treatment Adherence in Type 2 Diabetes Mellitus according to the disruptions of check-ups ($P < .05$). In the Dunn–Bonferroni multiple comparisons carried out to determine the originating group of the difference, it was found that there was a statistically significant difference between patients taking oral antidiabetics and diet and oral antidiabetics and those taking oral antidiabetics therapy had a higher anger feelings sub-scale score ($P < .05$) (Table 4).

It was found that there was a negative and weak relationship between PSS total and all sub-scales and Treatment Adherence in Type 2 Diabetes Mellitus total and sub-scales ($P < .05$). As the perceived stress level of individuals increased, the patients' level of adherence to treatment decreased in the treatment of type 2 diabetes (Table 5).

Discussion

Studies have revealed that the COVID-19 pandemic process has disrupted access to care in individuals with diabetes and has caused a great impact both physically and psychosocially on individuals who need constant checks and care.[1,13,18-20]

In our study, the perceived stress level (23.82 ± 8.34) was found to be moderate in individuals with diabetes. In studies conducted during the pandemic, it was found that individuals with diabetes had an increase in perceived stress compared to before the pandemic.[1,4] Siddharthan et al[13] found that about 2 out of every 5 hospitalized individuals with diabetes (39.3%) experienced stress. Sankar et al[20]

Table 2. Perceived Stress Level of Participants and Mean Scores of Patient Adherence Scales in Type 2 Diabetes Treatment

Scale and Sub-dimensions	$\bar{X} \pm SD$	Received Min-Max Scores
The perceived insufficient self-efficacy sub-scales	11.79 ± 4.20	0.00-24.00
perceived stress/distress sub-scales	12.02 ± 4.51	0.00-23.00
Total Perceived Stress Scale	23.82 ± 8.34	0.00-38.00
Attitude and emotional factors	26.37 ± 5.02	8.00-40.00
Awareness and personal factors	20.02 ± 3.63	6.00-30.00
Lifestyle change	9.92 ± 1.95	3.00-15.00
The feelings of anger	9.70 ± 2.23	3.00-15.00
emotions and behaviors appropriate for adherence	13.74 ± 3.99	4.00-43.00
Diet negotiation	10.12 ± 1.99	3.00-15.00
Feeling of denial	9.79 ± 2.21	3.00-15.00
Total Patient Adherence Scale in the Treatment of Type 2 Diabetes	99.69 ± 17.68	30.00-150.00

SD, standard deviation; $\bar{X}$, mean; min, minimum; max, maximum.

Table 3. Comparison of Participants' Characteristics and Perceived Stress Scale Scores (n = 184)

	Total Perceived Stress Scale and Sub-dimensions (X ± SD)		
Features of the Participants	**The Perceived İnsufficient Self-Efficacy**	**Perceived Stress/Distress**	**Overall Total**
Gender			
Female	11.52 ± 4.58	11.50 ± 4.85	23.02 ± 9.13
Male	12.10 ± 3.74	12.60 ± 4.06	24.70 ± 7.34
Statistical test and significance	t = -0. 93, *P* = .35	t = -0.1.66, *P* = .09	t = -0.1.37, *P* = .17
Marital status			
Married	11.77 ± 4.31	11.95 ± 4.58	23.73 ± 8.57
Single	11.90 ± 3.64	12.38 ± 4.23	24.29 ± 7.25
Statistical test and significance	t = -0.15, *P* = .88	t = -0.48, *P* = .62	t = -0.33, *P* = .73
Education level			
İlliterate	11.30 ± 4.48	11.48 ± 4.78	22.79 ± 8.94
Literate	12.32 ± 4.49	12.72 ± 4.72	25.05 ± 8.82
Primary school	12.38 ± 2.98	12.84 ± 3.54	25.23 ± 5.86
High school and above	11.81 ± 4.42	11.50 ± 4.52	23.31 ± 8.77
Statistical test and significance	KW = 0.98, *P* = .80	KW = 3.51, *P* = .31	KW = 2.15, *P* = .54
Occupation			
Unemployed	10.85 ± 4.63	10.67 ± 5.11	21.52 ± 9.32
Worker	11.60 ± 3.86	11.75 ± 3.70	23.35 ± 7.13
Civil servant	13.28 ± 4.63	13.57 ± 5.04	26.85 ± 9.29
Housewife	11.73 ± 4.43	11.77 ± 4.59	23.51 ± 8.74
Others	12.64 ± 3.09	13.89 ± 3.79	26.53 ± 6.48
Statistical test and significance	KW = 5.05, *P* = .16	KW = 5.11, *P* = .16	KW = 5.82, *P* = .12
Duration of disease			
1-5 year	10.79 ± 4.48	10.93 ± 5.03	21.72 ± 9.20
6-10 year	11.70 ± 3.97	12.21 ± 4.36	23.91 ± 8.04
11-15 year	13.07 ± 3.20	12.65 ± 2.99	25.73 ± 5.66
16 year and above	12.03 ± 5.09	12.57 ± 5.48	24.60 ± 10.10
Statistical test and significance	F = 2.18, *P* = .09	F = 1.36, *P* = .25	F = 1.77, *P* = .15
Treatment of the disease			
Insulin[a]	12.54 ±3.73	12.32 ± 3.89	24.86 ±7.20
Oral antidiabetic[b]	9.76 ± 4.94	10.37 ± 5.63	20.13 ± 10.30
Diet and oral antidiabetic[c]	12.43 ± 3.54	13.13 ± 3.98	23.66 ± 9.18
Diet only[d]	11.41 ± 4.58	12.25 ± 5.02	25.56 ± 7.16
Statistical test and significance	KW = 8.51, *P* = .03*	KW = 4.38, *P* = .22	KW = 6.50, *P* = .09
Difference	a-b**		
Another chronic disease			
Yes	11.68 ± 4.34	11.97 ± 4.63	23.65 ± 8.60
No	12.03 ± 3.92	12.12 ± 4.29	24.16 ± 7.87
Statistical test and significance	t = -0.53, *P* = .59	t = -0.21, *P* = .82	t = -0.38, *P* = .69
Passing COVID-19			
Yes	11.43 ± 4.39	11.58 ± 4.63	23.02 ± 8.66
No	12.55 ± 3.69	12.93 ± 4.14	25.48 ± 7.45
Statistical test and significance	t = -1.69, *P* = .09	t = -1.98, *P* = .04*	t = -1.98, *P* = .04*
Passing COVID-19 in your family			
Yes	11.67 ± 4.49	11.82 ± 4.75	23.49 ± 8.92
No	12.35 ± 2.49	12.94 ± 3.18	25.29 ± 4.95
Statistical test and significance	t = -0.85, *P* = .39	t = -1.30, *P* = .19	t = -1.13, *P* = .25
Disruption of controls during the pandemic process			
Yes	11.57 ± 4.45	11.68 ± 4.61	23.26 ± 8.74
No	12.61 ± 2.97	13.28 ± 3.91	25.89 ± 6.33
Statistical test and significance	t = -1.37, *P* = .17	t = -2.16, *P* = .03*	t = -2.10, *P* = .03*

SD, standard deviation; $\overline{X}$, means; F, ANOVA test; *t*, ındependent samples *t*-test; KW, Kruskal–Wallis test. Statistical significance was identified if the *$P < .05$, **Dunn–Bonferroni test

have found that 27.3% of individuals with diabetes were suffering from stress due to the spread of the COVID-19 pandemic and 20% were experiencing stress about the availability of medications. In their study, Ghosh et al[5] noted that 87% of individuals with type 2 diabetes experienced stress during the quarantine imposed during the COVID-19 pandemic, and in the same study, it was found that more than 80% of individuals were engaged in COVID-19 thoughts. In addition, before the pandemic, Bhandary et al[21] found in their study that individuals with diabetes (22.17%) had a higher level of stress than those without diabetes (16.92%). In other studies, it has been reported

Table 4. Comparison of Participants' Characteristics and Patient Adherence Scale Scores in the Treatment of Type 2 Diabetes (n = 184)

Features of the Participants	Patient Adherence Scale and Sub-dimensions in Type 2 Diabetes Treatment (X ± SD)							
	Attitude and Emotional Factors	Awareness and Personal Factors	Lifestyle Changes	The Feelings of Anger	Compatible Emotions and Behaviors	Diet Negotiation	Feeling of Denial	Overall Total
Gender								
Female	26.57 ± 4.84	20.11 ± 3.65	10.21 ± 1.95	9.76 ± 2.23	14.16 ± 4.92	10.22 ± 2.03	9.98 ± 2.25	101.05 ± 17.93
Male	26.15 ± 5.23	19.92 ± 3.64	9.61 ± 1.91	9.63 ± 2.24	13.28 ± 2.59	10.01 ± 1.95	9.59 ± 2.17	98.21 ± 17.37
Statistical test and significance	t = 0.55, *P* = .57	t = 0.36, *P* = .71	t = 2.11, *P* = .03*	t = 0.37, *P* = .70	t = 1.50, *P* = .13	t = 0.74, *P* = .45	t = 1.22, *P* = .22	t = 1.08, *P* = .27
Marital status								
Married	26.54 ± 5.03	20.11 ± 3.58	9.95 ± 1.88	9.73 ± 2.26	13.86 ± 4.21	10.22 ± 1.96	9.75 ± 2.15	100.19 ± 17.56
Single	25.51 ± 4.94	19.58 ± 3.92	9.80 ± 2.27	9.51 ± 2.11	13.16 ± 2.67	9.64 ± 2.07	10.00 ± 2.52	97.22 ± 18.38
Statistical test and significance	t = 1.04, *P* = .29	t = 0.73, *P* = .46	t = 0.38, *P* = .70	t = 0.50, *P* = .61	t = 0.89, *P* = .37	t = 1.42, *P* = .16	t = -0.55, *P* = .58	t = 0.85, *P* = .39
Education level								
Illiterate	26.56 ± 5.00	19.98 ± 3.74	9.87 ± 1.92	9.93 ± 2.17	14.06 ± 5.16	10.06 ± 2.01	9.84 ± 2.33	100.34 ± 18.34
Literate	25.72 ± 5.32	19.86 ± 3.46	9.86 ± 1.73	9.59 ± 2.40	13.29 ± 2.40	9.97 ± 1.92	9.70 ± 1.72	98.02 ± 16.91
Primary school	26.97 ± 4.70	20.16 ± 3.29	10.23 ± 2.12	9.74 ± 2.30	13.79 ± 2.56	10.56 ± 1.97	9.82 ± 2.30	101.74 ± 16.37
High school and above	25.63 ± 5.23	19.36 ± 4.15	9.72 ± 2.16	8.90 ± 1.99	13.13 ± 2.93	9.81 ± 2.08	9.72 ± 2.45	96.31 ± 19.04
Statistical test and significance	KW = 0.58, *P* = .90	KW = 2.36, *P* = .50	KW = 1.26, *P* = .73	KW = 3.19, *P* = .36	KW = 1.37, *P* = .71	KW = 2.74, *P* = .43	KW = 0.27, *P* = .96	KW = 1.69, *P* = .63
Occupation								
Unemployed	28.17 ± 5.29	21.11 ± 3.62	10.52 ± 2.27	10.32 ± 2.37	14.32 ± 2.39	10.61 ± 2.01	10.52 ± 2.25	105.61 ± 17.63
Worker	26.32 ± 5.73	20.02 ± 3.68	9.92 ± 1.85	9.67 ± 2.36	13.12 ± 2.63	10.30 ± 2.00	9.85 ± 1.87	99.22 ± 18.98
Civil servant	26.07 ± 3.60	20.64 ±3 .71	9.78 ± 2.11	9.21 ± 1.80	14.07 ± 2.61	10.50 ± 1.50	9.71 ± 2.49	100.00 ± 14.06
Housewife	25.82 ± 4.70	19.44 ± 3.50	9.82 ± 1.78	9.61 ± 2.15	13.92 ± 5.64	9.95 ± 1.97	9.55 ± 2.18	98.14 ± 17.76
Others	25.75 ± 4.75	19.78 ± 3.78	9.53 ± 1.95	9.42 ± 2.25	13.32 ± 2.78	9.50 ± 2.11	2.48 ± 9.79	96.78 ± 16.77
Statistical test and significance	KW = 4.5,9 *P* = .20	KW = 6.70, *P* = .08	KW = 3.08, *P* = .37	KW = 2.75, *P* = .43	KW = 7.95, *P* = .08	KW = 3.25, *P* = .35	KW = 5.51, *P* = .13	KW = 5.29, *P* = .15
Duration of disease								
1-5 year	26.47 ± 5.37	20.45 ± 4.01	9.91 ± 1.98	9.47 ± 2.33	13.77 ± 2.65	10.22 ± 2.06	9.81 ± 2.43	100.14 ± 18.53
6-10 year	26.51 ± 4.57	20.02 ± 3.29	10.08 ± 1.85	9.88 ± 2.07	14.21 ± 5.51	10.08 ± 1.88	9.94 ± 2.04	100.75 ± 16.81
11-15 year	25.44 ± 5.20	19.65 ± 3.63	9.65 ± 2.10	9.42 ± 2.16	13.18 ± 2.61	10.18 ± 1.94	9.65 ± 2.14	97.21 ± 17.92
16 year and above	27.10 ± 5.30	19.75 ± 3.91	9.92 ± 1.98	10.00 ± 2.56	13.28 ± 2.80	9.96 ± 2.26	9.60 ± 2.42	99.64 ± 18.64
Statistical test and significance	F = 0.65, *P* = .58	F = 0.40, *P* = .74	F = 0.39, *P* = .76	F = 0.67, *P* = .56	F = 0.69, *P* = .55	F = 0.12, *P* = .94	F = 0.21, *P* = .88	F = 0.34, *P* = .79
Treatment of the disease								
İnsülin[a]	26.13 ± 4.71	19.52 ± 3.43	9.77 ± 1.77	9.75 ± 2.07	13.03 ± 2.39	9.95 ± 1.90	9.52 ± 2.22	97.68 ± 16.28
Oral antidiabetic[b]	27.93 ± 5.40	21.00 ± 4.19	10.23 ± 2.18	10.39 ± 2.46	14.25 ± 2.90	10.53 ± 2.27	10.39 ± 2.26	104.74 ± 20.23
Diet and oral antidiabetic[c]	25.24 ± 4.98	20.21 ± 3.80	10.02 ± 2.11	9.10 ± 2.18	13.66 ± 1.55	10.08 ± 1.99	9.64 ± 2.26	99.27 ± 18.96
Diet only[d]	26.16 ± 5.30	19.75 ± 1.54	9.75 ± 2.00	8.66 ± 2.10	14.94 ± 7.28	10.08 ± 1.50	10.25 ± 1.48	98.33 ± 11.61
Statistical test and significance	KW = 4.75, *P* = .19	KW = 4.34, *P* = .22	KW = 2.61, *P* = .45	KW = 7.64, *P* = .05*	KW = 6.84, *P* = .07	KW = 2.22, *P* = .52	KW = 3.54, *P* = .31	KW = 3.43, *P* = .33
Difference				b-c**				

(*Continued*)

Table 4. Comparison of Participants' Characteristics and Patient Adherence Scale Scores in the Treatment of Type 2 Diabetes (n = 184) (*Continued*)

	Patient Adherence Scale and Sub-dimensions in Type 2 Diabetes Treatment (X ± SD)							
Features of the Participants	**Attitude and Emotional Factors**	**Awareness and Personal Factors**	**Lifestyle Changes**	**The Feelings of Anger**	**Compatible Emotions and Behaviors**	**Diet Negotiation**	**Feeling of Denial**	**Overall Total**
Another chronic disease								
Yes	26.54 ± 5.29	19.98 ± 3.82	9.94 ± 2.00	9.88 ± 2.20	13.54 ± 3.79	10.17 ± 2.09	9.77 ± 2.28	99.84 ± 1 8.71
No	26.03 ± 4.46	20.09 ± 3.26	9.90 ± 1.86	9.33 ± 2.26	14.14 ± 4.38	10.03 ± 1.78	9.85 ± 2.10	99.40 ± 15.61
Statistical test and significance	t = 0.65, *P* = .51	t = -0.19, *P* = .84	t = 012, *P* = .89	t = 1.57, *P* = .11	t = -0.96, *P* = .33	t = 0.44, *P* = .65	t = -0.24, *P* = .80	t = 0.15, *P* = .87
Passing COVID-19								
Yes	26.66 ± 5.40	20.04 ± 3.86	9.97 ± 2.00	9.98 ± 2.31	13.91 ± 4.62	10.15 ± 2.09	9.91 ± 2.27	100.54 ± 19.02
No	25.76 ± 4.10	19.98 ± 3.15	9.83 ± 1.85	9.31 ± 2.03	13.40 ± 2.18	10.06 ± 1.77	9.56 ± 2.08	97.93 ± 14.52
Statistical test and significance	t = 1.25, *P* = .21	t = 0.09, *P* = .92	t = 0.46, *P* = .64	t = 1.63, *P* = .10	t = 1.01, *P* = .31	t = 0.27, *P* = .78	t = 0.84, *P* = .32	t = 1.03, *P* = .30
Passing COVID-19 in your family								
Yes	26.64 ± 5.25	20.19 ± 3.87	10.04 ± 1.99	9.84 ± 2.26	13.88 ± 4.31	10.20 ± 2.08	9.83 ± 2.29	100.63 ± 18.67
No	25.20 ± 3.66	19.26 ± 2.21	9.44 ± 1.70	9.05 ± 1.98	13.14 ± 2.00	9.79 ± 1.49	9.64 ± 1.85	95.55 ± 11.74
Statistical test and significance	t = 1.50, *P* = .13	t = 1.87, *P* = .06	t = 1.62, *P* = .10	t = 2.03, *P* = .04*	t = 0.96, *P* = .33	t = 1.32, *P* = .19	t = 0.44, *P* = .65	t = 2.00, *P* = .04*
Disruption of controls during the pandemic process								
Yes	26.76 ± 5.09	20.20 ± 3.75	10.06 ± 1.94	9.90 ± 2.23	13.78 ± 4.31	10.13 ± 2.03	9.91 ± 2.20	100.76 ± 18.17
No	24.92 ± 4.50	19.35 ± 3.09	9.43 ± 1.94	8.94 ± 2.11	13.58 ± 2.52	10.07 ± 1.85	9.38 ± 2.24	95.71 ± 15.32
Statistical test and significance	t = 2.05, *P* = .03*	t = 1.28, *P* = .20	t = 1.78, *P* = .07	t = 2.39, *P* = .01*	t = 0.27, *P* = .78	t = 0.16, *P* = .86	t = 1.31, *P* = .18	t = 1.58, *P* = .11

SD, standard deviation; $\bar{X}$, means; F, ANOVA test; *t*, independent samples *t*-test; KW, Kruskal–Wallis test. Statistical significance was identified if the *$P < .05$, **Dunn–Bonferroni test.

Table 5. Examining the Relationship Between the Participants' Perceived Stress Level and the Mean Score of the Patient Adherence Scales in Type 2 Diabetes Treatment

Total Perceived Stress Scale	Patient Adherence Scale and Sub-dimensions in Type 2 Diabetes Treatment ($\bar{X} \pm SD$)							
	Attitude and Emotional Factors	Awareness and Personal Factors	Lifestyle Changes	The Feelings of Anger	Compatible Emotions and Behaviors	Diet Negotiation	Feeling of Denial	Overall Total
The perceived insufficient self-efficacy sub-scales	r = -0.35, P = .00*	r = -0.26, P = .00*	r = -0.27, P = .00*	r = -0.35, P = .00*	r = -0.20, P = .00*	r = -0.24, P = .00*	r = -0.37, P = .00*	r = -0.34, P = .00*
Perceived stress/distress sub-scales	r = -0.35, P = .00*	r = -0.25, P = .00*	r = -0.27, P = .00*	r = -0.36, P = .00*	r = -0.15, P = .04*	r = -0.27, P = .00*	r = -0.40, P = .00*	r = -0.34, P = .00*
Overall total	r = -0.37, P = .00*	r = -0.26, P = .00*	r = -0.28, P = .00*	r = -0.37, P = .00*	r = -0.18, P = .01*	r = -0.27, P = .00*	r = -0.40, P = .00*	r = -0.36, P = .00*

R, Pearson correlation. Statistical significance was identified if the $*P < .05$.

that individuals with diabetes experience moderate[22] to high[14] levels of stress. It can be stated that the chronic nature of diabetes mellitus disease, its inclusion in the risk group in the COVID-19 pandemic, and disruptions in the treatment process cause people with diabetes to experience stress.

In our study results, it was found that the perceived stress and perceived insufficient self-efficacy sub-scale mean scores were higher in those who used insulin. In their study of 433 individuals with diabetes treated by insulin, conducted before the pandemic, Yavuz et al[23] found that 20.3% of people treated with insulin had no adherence to daily treatment.[23] It can be stated that people with diabetes do not perform their insulin injections regularly due to painful procedure of the insulin therapy, and poor glycemic control due to this causes the development of potential complications, or disruptions in the treatment process due to the COVID-19 pandemic negatively affect people with diabetes, and this leads to stress in these individuals. Of the individuals with diabetes, those who had not had COVID-19 were found to have a higher perceived stress/distress sub-scale score average. Diabetes is one of the diseases in which COVID-19 patients are at high risk due to disease severity during hospitalization. It has also been stated that COVID-19 disease causes excessive stress variability and raises blood glucose in diabetics.[6,19] Since COVID-19 is a new disease, it can be stated that fear, anxiety, and uncertainty about what may happen to disrupt the psychosocial lives of individuals, and information about coronavirus cases that are increasing every day through social media cause stress in individuals with diabetes who have a fear of getting COVID-19. Of the individuals with diabetes, those who had not missed their check-ups during the pandemic were found to have a higher perceived stress/distress sub-scale score average. Sankar et al[20] have found that 36.3% of individuals with diabetes experience stress about missing appointments with their physician. In another study, it was found that quarantine during the pandemic increases the carbohydrate intake in people with diabetes, which leads to an increase in body weight and also causes an imbalance of blood glucose levels in the body.[5] Inability to go to health appointments during the pandemic and difficulties in obtaining diabetes medications and supplies may have caused them to experience stress due to the fear that their checks may be disrupted.

In this study, individuals with diabetes were found to have a moderate level of adherence to treatment score average (99.69 ± 17.68). In addition, 0.5% of the individuals had "good" adherence to treatment, 94.6% had "moderate" adherence to treatment, and 4.9% had "poor" adherence to treatment. A study conducted in Saudi Arabia found significantly reduced adherence to treatment in individuals with diabetes during the pandemic.[24] In their study, Eşer et al[25] reported no individuals with poor adherence to treatment among individuals with diabetes, while 8 individuals (2.6%) were found to have good adherence and 295 individuals (97.4%) were found to have moderate adherence to treatment. In their meta-analysis study, Krass et al[26] found that the medication compliance of individuals with diabetes was between 38.5% and 93%. Baykal et al.[27] however, reported that 66.2% of the individuals showed good adherence to treatment, 29.3% had moderate adherence, and 4.5% had poor adherence to treatment.[27] The adherence to treatment status of individuals with diabetes was found by Rezaie et al[11] as 85%, by Presetiawati et al[28] as 54%, and in the systematic review by Mashrouteh et al[29] as 37.2%-87%. In other studies, it has been found that individuals with diabetes have a moderate level of adherence to treatment.[7,12] Previous studies report that the majority of people with diabetes have a moderate level of adherence to treatment. However, it can be stated that more studies are needed to evaluate the adherence to treatment in individuals with diabetes during the pandemic.

In our study, the adherence to treatment lifestyle change sub-scale score of the women was found to be above average. The study by Elsous et al[7] found that adherence to treatment was higher in females. In another study, it was found that the level of medication compliance and lifestyle habits before and after the quarantine was not affected.[24] In many studies, it has been found that there is no significant difference in adherence to treatment levels according to gender.[25,30-32] It can be stated that the difference in the research findings is due to sociodemographic characteristics. It was found that individuals with diabetes mellitus who used oral antidiabetics in the treatment of the disease had higher adherence to treatment and anger feelings sub-scale score averages. Looking at the literature, in their study of 433 people with diabetes treated by insulin, Yavuz et al[23] found that 20.3% of people treated with insulin had no adherence to daily treatment.[23] Treatment of type 2 diabetes begins with oral antidiabetic drugs, diet, exercise, and lifestyle changes, as well as glycemic control, is expected to be achieved. However, in stressful situations, such as failure to achieve the expected lifestyle change, accompanying illness, and surgical procedures, insulin is added to the treatment plan.[33,34] It may have caused feelings of anger due to insufficient glycemic control. It was found that the individuals with diabetes who had family members that got COVID-19 had higher general and anger feelings sub-scale score average. In their study, Yan et al[9] found that 32 (66.7%) individuals with diabetes were admitted to the intensive care unit, their hospital stay was longer, and they had a higher mortality rate. In the light of this information, it can be stated that both the disease management and the presence of COVID-19 sufferers in the family and their anxiety about getting COVID-19 have led to feelings of anger in individuals. It was found that the individuals with diabetes and those who missed their check-ups during the pandemic had higher attitude and emotional factors and anger feelings sub-scale averages. Looking at the literature, Önmez et al[3] observed in their study that there was a significant increase in fasting glucose levels in individuals with diabetes during the pandemic. A study conducted in India also found that 87% of individuals with diabetes visited their physicians less frequently during the COVID-19 pandemic, and the majority (88%) did not have access to health care services.[35] Conditions such as inability to go to hospitals regularly and interruption of treatment due to anxiety about getting COVID-19 infection and inability to perform critical interventions under the supervision of a physician may have negatively affected the adherence to treatment in individuals with diabetes and associated feelings of anger.

Our study results showed that the level of adherence to treatment decreased as the perceived stress level of individuals with diabetes increased. In a study conducted during the pandemic, it was found that although increased perceived stress levels in people with type 2 diabetes resulted in weight gain and less exercise, it did not adversely affect glycemic control.[1] However, in the same study, one-third of individuals expressed a high level of stress in connection with difficulties in glycemic control.[1] In their study, Ghosal et al[8] found that durations of quarantines imposed due to the pandemic had a direct relationship with treatment non-compliance in individuals with diabetes, and accordingly, diabetes-related complications and uncontrolled glycemia were found to increase. The real-time and continuous flow of news related to the pandemic, the measures taken to prevent the spread of the disease throughout the pandemic, and the isolation applied bring about radical changes in daily life. It can be stated that these changes lead to increased perceived stress, limited access to health care, decreased physical activity, and decreased adherence to treatment in individuals with diabetes.

Study Limitation

Considering the magnitude of the spread of the COVID-19 pandemic, the single-centered, hospital-based, small sample size nature of this research constitutes the limitation of the study.

Conclusion

It was found that the level of perceived stress and adherence to treatment in individuals with type 2 diabetes was moderate, and the level of adherence to treatment was also found to decrease with increasing perceived stress levels. As a continuing dynamic process, the COVID-19 pandemic will cause stress in individuals with diabetes, who are in the risk group. This will also negatively affect the adherence to treatment in individuals with diabetes. Evaluation of the stress experienced by people with diabetes and the impact of stress on adherence to treatment during the COVID-19 pandemic will contribute to the nursing care process aimed at preventing comorbidities that may occur in these individuals. It is recommended that nurses evaluate individuals with diabetes in terms of stress and adherence to treatment, check individuals more often, and ensure that they come to their check-ups regularly. Studies are proposed to determine the extent to which individuals with diabetes are physically, socially, and emotionally affected by the COVID-19 pandemic. In addition, it is recommended to repeat the research with a larger sample size in groups with different chronic diseases.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Siirt Non-Interventional Clinical Research Ethics Committee (Date: December 31, 2020, Decision No:14178).

Informed Consent: Verbal and Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – Z.B.; Design – Z.B., M.A.; Supervision – Z.B., M.A.; Resources – Z.B., M.A., A.G.; Materials – M.A.; Data Collection and/or Processing – Z.B., A.G.; Analysis and/or Interpretation – Z.B., M.A.; Literature Search – Z.B., M.A.; Writing Manuscript – Z.B., M.A., A.G.; Critical Review – Z.A., M.A..

Conflict of Interest: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

References

1. Ruissen MM, Regeer H, Landstra CP, et al. Increased stress, weight gain and less exercise in relation to glycemic control in people with type 1 and type 2 diabetes during the COVID-19 pandemic. *BMJ Open Diabetes Res Care*. 2021;9(1):1-7. [CrossRef]
2. World Health Organization (WHO). *World Health Organization Website*. 2021. Available at: https://www.who.int, Accessed November 26, 2020.
3. Önmez A, Gamsızkan Z, Özdemir Ş, et al. The effect of COVID-19 lockdown on glycemic control in patients with type 2 diabetes mellitus in Turkey. *Diabetes Metab Syndr*. 2020;14(6):1963-1966. [CrossRef]
4. Fisher L, Polonsky W, Asuni A, Jolly Y, Hessler D. The early impact of the COVID-19 pandemic on adults with type 1 or type 2 diabetes: a national cohort study. *J Diabetes Complications*. 2020;34(12):107748. [CrossRef]
5. Ghosh A, Arora B, Gupta R, Anoop S, Misra A. Effects of nationwide lockdown during COVID-19 epidemic on lifestyle and other medical issues of patients with type 2 diabetes in North India. *Diabetes Metab Syndr*. 2020;14(5):917-920. [CrossRef]
6. Verma AK, Beg MMA, Bhatt D, et al. Assessment and management of diabetic patients during the COVID-19 pandemic. *Diabetes Metab Syndr Obes*. 2021;14:3131-3146. [CrossRef]

7. Elsous A, Radwan M, Al-Sharif H, Abu Mustafa A. Medications adherence and associated factors among patients with type 2 diabetes mellitus in the Gaza Strip, Palestine. *Front Endocrinol*. 2017;8(100):100. [CrossRef]
8. Ghosal S, Sinha B, Majumder M, Misra A. Estimation of effects of nationwide lockdown for containing coronavirus infection on worsening of glycosylated haemoglobin and increase in diabetes-related complications: a simulation model using multivariate regression analysis. *Diabetes Metab Syndr*. 2020;14(4):319-323. [CrossRef]
9. Yan Y, Yang Y, Wang F, et al. Clinical characteristics and outcomes of patients with severe COVID-19 with diabetes. *BMJ Open Diabetes Res Care*. 2020;8(1):1-9. [CrossRef]
10. Hara Y, Hisatomi M, Ito H, Nakao M, Tsuboi K, Ishihara Y. Effects of gender, age, family support, and treatment on perceived stress and coping of patients with type 2 diabetes mellitus. *Biopsychosoc Med*. 2014;8(16):16. [CrossRef]
11. Rezaei M, Valiee S, Tahan M, Ebtekar F, Ghanei Gheshlagh R. Barriers of medication adherence in patients with type-2 diabetes: a pilot qualitative study. *Diabetes Metab Syndr Obes*. 2019;12:589-599. [CrossRef]
12. Özkaptan BB, Kapucu S, Demirci İ. Tip 2 diyabetli hastalarda tedaviye uyum ve hastalık kabulü arasındaki ilişki. *Cukurova Med J*. 2019;44:447-454. [CrossRef]
13. Siddharthan GM, Reddy MM, Sunil BN. Perceived stress and its associated factors among diabetic patients receiving care from a rural tertiary health care center in South India. *J Educ Health Promot*. 2021;10:11. [CrossRef]
14. Zhao FF, Suhonen R, Katajisto J, Leino-Kilpi H. The association of diabetes-related self-care activities with perceived stress, anxiety, and fatigue: a cross-sectional study. *Patient Prefer Adherence*. 2018;12:1677-1686. [CrossRef]
15. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav*. 1983;24(4):385-396. [CrossRef]
16. Eskin M, Harlak H, Demirkıran F, Dereboy Ç. Algılanan stres ölçeğinin türkçeye uyarlanması: güvenirlik ve geçerlik analizi. [Adapt perceived stress scale Turk reliab validity]. *Yeni Symp J*. 2013;51(3):132-140.
17. Demirtaş A, Akbayrak N. Development of an assessment scale for treatment compliance in type 2 diabetes mellitus in Turkish population: psychometric evaluation. *Int J Nurs Sci*. 2017;4(3):244-251. [CrossRef]
18. Brooks SK, Webster RK, Smith LE, et al. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet*. 2020;395(10227):912-920. [CrossRef]
19. Rajpal A, Rahimi L, Ismail-Beigi F. Factors leading to high morbidity and mortality of COVID-19 in patients with type 2 diabetes. *J Diabetes*. 2020;12(12):895-908. [CrossRef]
20. Sankar P, Ahmed WN, Mariam Koshy V, Jacob R, Sasidharan S. Effects of COVID-19 lockdown on type 2 diabetes, lifestyle and psychosocial health: a hospital-based cross-sectional survey from South India. *Diabetes Metab Syndr*. 2020;14(6):1815-1819. [CrossRef]
21. Bhandary B, Rao S, T S S. The effect of perceived stress and family functioning on people with type 2 diabetes mellitus. *J Clin Diagn Res*. 2013;7(12):2929-2931. [CrossRef]
22. Lang VB, Marković BB, Vrdoljak D. The association of lifestyle and stress with poor glycemic control in patients with diabetes mellitus type 2: a Croatian nationwide primary care cross-sectional study. *Croat Med J*. 2015;56(4):357-365. [CrossRef]
23. Yavuz DG, Ozcan S, Deyneli O. Adherence to insulin treatment in insulin-naïve type 2 diabetic patients initiated on different insulin regimens. *Patient Prefer Adherence*. 2015;9:1225-1231. [CrossRef]
24. Alshareef R, Al Zahrani A, Alzahrani A, Ghandoura L. Impact of the COVID-19 lockdown on diabetes patients in Jeddah, Saudi Arabia. *Diabetes Metab Syndr*. 2020;14(5):1583-1587. [CrossRef]
25. Eşer AK, Doğan EN, Kav S, Bulut Y. Tip 2 diabetes mellitus tedavisinde hasta uyumunun değerlendirilmesi. *Ege Univ Hemşire Fak Derg*. 2018;34(2):64-76.
26. Krass I, Schieback P, Dhippayom T. Adherence to diabetes medication: a systematic review. *Diabet Med*. 2015;32(6):725-737. [CrossRef]
27. Baykal A, Tip KS. Tip 2 diyabetes mellituslu hastaların tedavilerine uyumlarının değerlendirilmesi. *Hacet Univ Hemşire Fak Derg*. 2015;2(2):44-58.
28. Presetiawati I, Andrajati R, Sauriasari R. Effectiveness of a medication booklet and counseling on treatment adherence in type 2 diabetes mellitus patients. *Int J App Pharm*. 2017;9. [CrossRef]
29. Mashrouteh M, Khanjani N. Evaluation of oral medication adherence and its related factors in type 2 diabetic patients in Iran: a systematic review. *Int J Diabetes Res*. 2017;6(1):24-33.
30. Alqarni AM, Alrahbeni T, Qarni AA, Qarni HMA. Adherence to diabetes medication among diabetic patients in the Bisha Governorate of Saudi Arabia: a cross-sectional survey. *Patient Prefer Adherence*. 2019;13:63-71. [CrossRef]
31. Jimmy B, Jose J, Al-Hinai ZA, Wadair IK, Al-Amri GH. Adherence to medications among type 2 diabetes mellitus patients in three districts of Al Dakhliyah Governorate, Oman: a cross-sectional pilot study. *Sultan Qaboos Univ Med J*. 2014;14(2):e231-e235.
32. Sweileh WM, Zyoud SH, Abu Nab'a RJ, et al. Influence of patients' disease knowledge and beliefs about medicines on medication adherence: findings from a cross-sectional survey among patients with type 2 diabetes mellitus in Palestine. *BMC Public Health*. 2014;14:94. [CrossRef]
33. Hayashino Y, Izumi K, Okamura S, et al. Duration of diabetes and types of diabetes therapy in Japanese patients with type 2 diabetes: the Japan diabetes complication and its prevention prospective study 3 (JDCP study 3). *J Diabetes Investig*. 2017;8(2):243-249. [CrossRef]
34. Marín-Peñalver JJ, Martín-Timón I, Sevillano-Collantes C, Del Cañizo-Gómez FJ. Update on the treatment of type 2 diabetes mellitus. *World J Diabetes*. 2016;7(17):354-395. [CrossRef]
35. Khader MA, Jabeen T, Namoju R. A cross sectional study reveals severe disruption in glycemic control in people with diabetes during and after lockdown in India. *Diabetes Metab Syndr*. 2020;14(6):1579-1584. [CrossRef]