



***The association between medication adherence and quality of life in patients with diabetes at primary healthcare centers: A cross-sectional study***

**Birinci Basamakta Tip 2 Diyabet Hastalarının İlaç Uyumu ve Yaşam Kalitesi İlişkisi: Kesitsel Bir Çalışma**

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**Abstract**

**Aim:** This study aimed to evaluate the association between medication adherence and quality of life in patients with diabetes receiving primary healthcare centers.

**Method:** Patients with type 2 diabetes, aged 18-65 between July and October 2022, were included in this cross-sectional study. A questionnaire including sociodemographic characteristics, the Diabetes Quality of Life (DQOL) scale, and the Modified Morisky Scale (MMS) were used.

**Results:** Two hundred nine patients with type 2 diabetes participated in this study. The mean age of the participants was 53.5±9.2 years, and 51.7% were women. The mean DQOL score of the participants was 3.8±0.7. Quality of life was higher among married participants and those with medium-high income, diagnosed with diabetes <5 years previously, without diabetes complications, using only oral antidiabetic drugs for the treatment of diabetes, who regularly used diabetes medications, who dieted and exercised for diabetes, and who regularly attended diabetes follow-up (p<0.05). Quality of life was also higher in those with better MMS showing a better medication adherence motivation and knowledge levels (p<0.01).

**Conclusions:** Participants' medication adherence motivation and knowledge levels were associated with an increased quality of life. Admission to primary healthcare centers for diabetes follow-up was also associated with a higher quality of life.

**Keywords:** diabetes mellitus, quality of life, medication adherence, primary care

**Özet**

**Amaç:** Bu çalışmada, birinci basamakta tip 2 diyabet hastalarının ilaç uyumu ve yaşam kalitesi ilişkisinin değerlendirilmesi amaçlandı. **Yöntem:** Bu kesitsel tipte çalışmaya Temmuz-Ekim 2022 tarihleri arasında 18-65 yaş arası tip 2 diyabet hastaları dahil edildi. Katılımcılara bir anket uygulandı. Ankette sosyodemografik özellikler, Diyabet Yaşam Kalitesi Ölçeği (DYKÖ) ve Modifiye Morisky Ölçeği (MMÖ) yer aldı.

**Bulgular:** Çalışmaya toplam 209 tip 2 diyabet hastası katıldı. Katılımcıların yaş ortalaması 53,5±9,2 yıl ve %51,7'si kadındı. Katılımcıların DYKÖ puan ortalaması 3,8±0,7 bulundu. MMÖ ortalama puanı 4,09±2,09 bulundu. Katılımcılardan evli olanların, gelir durumu orta-yüksek olanların, diyabet tanı süresi <5 yıl olanların, diyabet komplikasyonu olmayanların, diyabet tedavisi olarak sadece oral antidiyabetik kullananların, diyabet ilaçlarını düzenli kullananların, diyabete yönelik diyet ve egzersiz yapanların ve diyabet kontrollerine düzenli gidenlerin yaşam kalitesi daha yüksek bulundu (p<0,05). MMÖ ilaç uyumu motivasyon düzeyi ve bilgi düzeyi yüksek olanların yaşam kalitesi daha yüksek bulundu (p<0,01).

**Sonuç:** Katılımcıların ilaç uyumu motivasyon ve bilgi düzeyleri artan yaşam kalitesi ile ilişkiliydi. Diyabet kontrolleri için birinci basamağa başvuru yüksek yaşam kalitesi ile ilişkiliydi.

**Anahtar kelimeler:** diabetes mellitus, yaşam kalitesi, tedavi uyumu, birinci basamak

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## Introduction

Type 2 diabetes mellitus (DM) is the most frequently seen form of diabetes, representing more than 90% of all cases of diabetes worldwide. According to the International Diabetes Federation (IDF) Atlas, the prevalence of diabetes in Türkiye has increased from 8.1% in 2011 to 14.5% by 2021. Türkiye has the highest prevalence of diabetes among European countries and the highest number of cases.<sup>1</sup> Studies performed in Türkiye at 12-year intervals indicated a striking 90% increase in the prevalence of DM.<sup>2</sup>

Medication adherence among patients with diabetes ranged from 36% to 93%.<sup>3</sup> Patients with poor medication adherence have a greater risk of developing complications capable of affecting their quality of life and health status.<sup>4</sup> The development of complications in patients with type 2 DM can be prevented to a significant extent through lifestyle modifications and good medication adherence.<sup>5</sup> Treatment adherence, regular health follow-up, healthy nutrition, and regular physical exercise are essential to keep diabetes under control. However, patients with diabetes may not always comply with the treatment and lifestyle modifications. This leads to several adverse health outcomes such as increased risks of hospitalization, morbidity, and mortality.<sup>6</sup>

Targeted interventions and a better understanding of non-adherence have been shown to be required in order to improve medication compliance in patients with diabetes.<sup>7</sup> Lifelong treatment affects the quality of life of diabetic patients. Therefore, quality of life is an essential indicator for evaluating the effectiveness of any disease management plan.<sup>8</sup> Medication adherence is also an essential determinant of the diabetes-specific quality of life. Better quality of life among patients is associated with better medication adherence.<sup>9</sup> Studies examining the quality of life and medication adherence of patients with type 2 DM have largely been conducted in secondary and tertiary health institutions.<sup>4,9,10</sup> The present study aimed to examine the relationship between quality of life and medication adherence in patients with type 2 DM presenting to primary healthcare centers.

## Material and Methods

### Study design and participants

This cross-sectional, descriptive study was conducted between July and September 2022 in four units of two education family health centers (E-FHCs) affiliated with Ondokuz Mayıs University. The study was carried out in two family medicine units of Aziziye Education Family Health Center in İlkadım district and in two family medicine units of Pelitköy Education Family Health Center in Atakum district. The research population consisted of patients aged 18-65 diagnosed with type 2 DM at least one year previously and presenting to E-FHCs. There were 450 type 2 DM patients in that time period. The study sample was calculated with the Openepi program. The sample size was calculated as 208 with 95% confidence interval ( $\alpha=0.05$ ), 5% margin of error, and 50% likelihood ratio. Of the 450 type 2 DM patients, 297 presented to the E-FHCs during the study period. Patients were accepted in the order they arrived. No sampling method was used. Eighty eight patients were excluded. Patients with diabetes other than type 2 or with obstacles to communication (such as mental disability, hearing problems, or speech difficulties) were excluded. Forty four patients were excluded because they were over 65 years of age, 38 patients were excluded because they did not want to participate, 3 patients were excluded because of communication problems, and 3 patients were excluded because they had diabetes other than type 2 DM. The participants were enrolled based on the order of their arrival at the clinic. This study was conducted in compliance with the principles of the Declaration of Helsinki. Ethics committee approval was obtained from Ondokuz Mayıs University Clinical Research Ethics Committee (OMÜKA EK 2022/251) prior to the study. The study had the approval of the Samsun Provincial Directorate of Health for the conduct of the study.

### Data Collection Tools

The first two sections of the questionnaire were developed after a review of the relevant literature.<sup>5,10-13</sup> A 15-member pilot study was conducted using the created questionnaire. Any requisite amendments concerning comprehensibility and fluidity were then performed, after which the questionnaire assumed its final form. It consisted of four sections. The first consisted of eight items regarding the participant's sociodemographic characteristics. The second contained a participant declaration-based diabetes diagnosis, treatment, and follow-up form (11 items); the third contained the Diabetes Quality of Life (DQOL) scale (45 items); and the fourth contained the Modified Morisky Scale (MMS) (six items). The purpose of the study was explained to the participants at the beginning of the questionnaire, which was administered in a face-to-face manner.

The sociodemographic information form included age, sex, height, weight, marital status, income, education, occupation, and household members.

Participants' declaration-based diabetes diagnosis, treatment, and follow-up forms inquired the duration of the patient's diabetes, diabetes-related complications, information about diabetes, treatment methods, regular use of diabetes medications, frequency of physician follow-up, presentation to primary healthcare centers for follow-up, diet, and regular exercise.

### ***Diabetes Quality Of Life (DQOL) Scale***

The DQOL scale was developed by the Diabetes Control and Complications Trial Research Group.<sup>14</sup> It was adapted into Turkish by Yıldırım et al. Each response given regarding satisfaction, impact, and worries about diabetes is scored between 5 (very satisfied) and 1 (very dissatisfied). In contrast to the original scale, reverse scoring is applied for ease of interpretation. In contrast to the original version, higher scores on the Turkish version indicate a better quality of life. For a better quality of life scale, it is recommended that quality of life scores be converted to a score between 1 and 5.<sup>11</sup> The DQOL scale's Cronbach alpha coefficient in this study was, with subscale coefficients between 0.84 and 0.95.

### ***Modified Morisky Scale (MMS)***

The Morisky Scale was developed by Morisky et al. for the evaluation by family physicians of medication adherence in patients using antihypertensive drugs.<sup>15</sup> In the “*Case Management Adherence Guideline-1 (CMAG-1)*”, the Modified Morisky Scale (MMS) was developed by adding two more questions to the Morisky scale in order to better evaluate the drug-taking behavior and compliance results. It also assists with the classification of patients' medication adherence and motivation levels as high or low.<sup>16</sup> The scale was adapted into Turkish by Vural et al. It consists of six yes/no questions. Total scores from the three questions measuring motivation and knowledge levels of 0 or 1 indicate low motivation/knowledge, while scores of 2 or 3 indicate high motivation/knowledge.<sup>13</sup>

### **Statistical analysis**

The study data were analyzed on IBM SPSS Statistics version 21.0 software. Categorical data were expressed as numbers and percentages, and continuous variables were expressed as mean±standard deviation. The chi-square test was used to compare categorical data. Data distribution was assessed with tests and graphics. Continuous variables exhibiting normal distribution were compared using the independent samples t-test and ANOVA. The relationship between medication adherence and quality of life was assessed using correlation analysis. The main and interaction effects of medication adherence motivation and knowledge levels on the quality of life subdimensions were evaluated using MANOVA. p values <0.05 were regarded as statistically significant.

### **Results**

A total of 209 patients with type 2 DM participated in this study. The participants' mean age was 53.5±9.2 years, 51.7% were women, 77.5% were married, 59.8% had a moderate perceived income level, 16.7% lived alone, and 38.8% had been diagnosed with diabetes less than five years previously. In addition, 76.6% of patients were using only OAD for the treatment of diabetes, while 45.9% were in diets for diabetes, and 33.5% performed exercise. Additionally, 45.5% of the patients presented to a primary healthcare centers for diabetes follow-up (Table 1).

**Table 1:** *Characteristics of the participants*

Variable	Category	n (%)
Sex	Male	101 (48.3)
	Female	108 (51.7)
Marital status	Married	162 (77.5)
	Unmarried	47 (22.5)
Education level	High school or above	104 (49.8)
	Elementary school or lower	105 (50.2)
Perceived income level	Low	71 (34.0)
	Moderate	125 (59.8)
	High	13 (6.2)
Living alone	No	174 (83.3)
	Yes	35 (16.7)
Duration of type 2 DM	<5 years	81 (38.8)
	5-10 years	67 (32.0)
	>10 years	61 (29.2)
Diabetes complications	Yes	42 (20.1)
	No	167 (79.9)
Information received about diabetes	Yes	178 (85.2)
	No	31 (14.8)
Diabetes treatment	OAD alone	160 (76.6)
	OAD and insulin	36 (17.2)
	Insulin alone	13 (6.2)
Regular use of diabetes medications	Yes	154 (73.7)
	No	55 (26.3)
Diet for diabetes	Yes	96 (45.9)
	No	113 (54.1)
Exercise for diabetes	Yes	70 (33.5)
	No	139 (66.5)
Frequency of diabetes follow-up	Once every 3 months	44 (21.1)
	Once every 6 months	57 (27.3)
	Once a year	54 (25.8)
	Irregular	54 (25.8)
Presentation to primary healthcare centers for diabetes follow-up	Yes	95 (45.5)
	No	114 (54.5)

In this study, 31.1% of the participants had a low level of medication adherence motivation on the MMS, and 28.7% had a low level of medication adherence knowledge. The participants' mean total DQOL score was  $3.8 \pm 0.7$ , while mean DQOL subdimension scores were  $3.5 \pm 0.9$  for satisfaction with treatment,  $3.7 \pm 0.7$  for the psychological impact of treatment,  $3.9 \pm 0.9$  for diabetes-related worry, and  $4.6 \pm 0.6$  for social/vocational worry. All DQOL scores were higher among participants with higher medication adherence motivation and knowledge levels ( $p < 0.001$ ) (Table 2).

Participants educated to high school level or above ( $p < 0.001$ ), with moderate-high perceived income levels ( $p = 0.008$ ), with durations of DM shorter than five years ( $p = 0.033$ ), with no diabetes complications ( $p < 0.001$ ), who had been informed about diabetes ( $p < 0.001$ ), who used only oral antidiabetic drugs (OADs) as diabetes treatment ( $p = 0.003$ ), and who attended regular diabetes follow-up ( $p < 0.001$ ) registered higher satisfaction with treatment scores (Table 2).

The psychological impact of treatment scores were higher among participants educated to high school level or above ( $p < 0.001$ ), with moderate-high perceived income levels ( $p = 0.026$ ), with durations of DM shorter than five years ( $p = 0.001$ ), with no diabetes complications ( $p < 0.001$ ), who had been informed about diabetes ( $p = 0.006$ ), who used only OADs as diabetes treatment ( $p < 0.001$ ), who attended regular diabetes follow-up once every three or six months ( $p < 0.001$ ), and who presented to primary healthcare centers for diabetes follow-up ( $p = 0.019$ ) (Table 2).

Diabetes-related worry scores were higher among male participants ( $p = 0.020$ ), married individuals ( $p = 0.001$ ), those educated to high school level or above ( $p = 0.001$ ), with moderate-high perceived income levels ( $p < 0.001$ ), who did not live alone ( $p < 0.001$ ), among those with durations of DM shorter than five years compared to those with durations of 10 years or longer ( $p = 0.017$ ), those without diabetes complications ( $p < 0.001$ ), who had been informed about diabetes ( $p = 0.005$ ), who used only OADs as diabetes treatment ( $p < 0.001$ ), who attended regular diabetes follow-up once every three or six months ( $p < 0.001$ ), who used diets for diabetes ( $p < 0.001$ ), who performed exercise for diabetes ( $p < 0.001$ ), and who regularly used diabetes medications ( $p < 0.001$ ) (Table 2).

Social/vocational worry scores were higher among married participants ( $p = 0.003$ ), those not living alone ( $p = 0.003$ ), participants without diabetes complications ( $p = 0.005$ ), who had been informed about diabetes ( $p = 0.033$ ), who used only OADs as diabetes treatment ( $p < 0.001$ ), who attended regular diabetes follow-up ( $p = 0.001$ ), who used diabetes medications regularly ( $p < 0.001$ ), and who presented to primary healthcare centers for diabetes follow-up ( $p = 0.041$ ) (Table 2).

Participants with durations of DM shorter than five years had higher DQOL scores than the others ( $p = 0.006$ ). Total DQOL scores were higher among participants with no diabetes complications, who had been informed about the disease, who used only OADs as diabetes treatment, who used diabetes medications regularly, who used diets and exercise for diabetes, and who attended diabetes follow-up once every three or six months ( $p < 0.001$ ). Participants attending primary healthcare centers for diabetes follow-up also had higher total DQOL scores ( $p = 0.025$ ) (Table 2).

**Table 2.** A comparison of participants' DQOL scale (and subdimension) scores according to their sociodemographic characteristics and medication adherence motivation/ knowledge

Variable	Category	Satisfaction		Impact		Worry: diabetes related		Worry: social/vocational		Total DQOL score	
		Mean±SD	p*	Mean±SD	p*	Mean±SD	p*	Mean±SD	p*	Ort±SS	p*
Sex	Male	3.5±0.9	0.995	3.8±0.7	0.140	4.1±0.9	<b>0.020</b>	4.6±0.6	0.221	3.8±0.7	0.275
	Female	3.5±0.9		3.6±0.7		3.8±0.9		4.5±0.6		3.7±0.7	
Marital status	Married	3.5±0.9	0.153	3.8±0.7	0.096	4.1±0.8	<b>0.001</b>	4.7±0.5	<b>0.003</b>	3.9±0.6	<b>0.037</b>
	Unmarried	3.3±0.9		3.5±0.8		3.5±1.0		4.3±0.8		3.6±0.8	
Education	High school or above	3.7±0.9	<b>&lt;0.001</b>	3.9±0.6	<b>&lt;0.001</b>	4.1±0.9	<b>0.001</b>	4.6±0.6	0.931	4.0±0.6	<b>&lt;0.001</b>
	Elementary school or lower	3.3±0.9		3.5±0.7		3.7±0.9		4.6±0.5		3.6±0.7	
Perceived income level	Low	3.3±0.9a	<b>0.008</b>	3.6±0.7a	<b>0.026</b>	3.6±1.0a	<b>&lt;0.001</b>	4.5±0.5	0.317	3.6±0.7a	<b>0.005</b>
	Moderate	3.6±0.9b		3.8±0.7b		4.1±0.8b		4.6±0.6		3.9±0.6b	
	High	4.1±0.8b		4.0±0.6b		4.4±0.7b		4.8±0.3		4.2±0.6b	
Living alone	No	3.5±0.9	0.438	3.8±0.7	0.135	4.0±0.9	<b>&lt;0.001</b>	4.6±0.5	<b>0.003</b>	3.8±0.6	0.086
	Yes	3.4±0.9		3.5±0.8		3.4±1.0		4.3±0.7		3.6±0.8	
Duration of type 2 diabetes	<5 years	3.7±0.9a	<b>0.033</b>	3.9±0.6a	<b>0.001</b>	4.1±0.8a	<b>0.017</b>	4.6±0.6	0.589	4.0±0.6a	<b>0.006</b>
	5-10 years	3.4±0.9b		3.6±0.7b		3.8±0.9ab		4.6±0.5		3.7±0.6b	
	>10 years	3.3±0.9b		3.5±0.7b		3.7±0.9b		4.5±0.7		3.6±0.7b	
Diabetes complications	Yes	3.1±0.9	<b>&lt;0.001</b>	3.3±0.7	<b>&lt;0.001</b>	3.3±0.9	<b>&lt;0.001</b>	4.3±0.7	<b>0.005</b>	3.4±0.7	<b>&lt;0.001</b>
	No	3.6±0.9		3.8±0.6		4.1±0.8		4.7±0.5		3.9±0.6	
Receipt of information about diabetes	Yes	3.6±0.9	<b>&lt;0.001</b>	3.8±0.7	<b>0.006</b>	4.0±0.8	<b>0.005</b>	4.6±0.6	<b>0.033</b>	3.9±0.8	<b>&lt;0.001</b>
	No	3.0±1.0		3.4±0.8		3.4±1.0		4.4±0.7		3.4±0.8	
Diabetes treatment	OADs alone	3.6±1.0a	<b>0.003</b>	3.9±0.6a	<b>&lt;0.001</b>	4.1±0.9a	<b>&lt;0.001</b>	4.7±0.5a	<b>&lt;0.001</b>	3.9±0.6a	<b>&lt;0.001</b>
	OADs and insulin	3.2±0.9b		3.2±0.8b		3.5±1.0b		4.4±0.7b		3.4±0.7b	
	Insulin alone	3.0±0.7b		3.2±0.6b		3.5±0.7b		4.1±0.8b		3.3±0.6b	
Regular use of diabetes medications	Yes	3.8±0.8	<b>&lt;0.001</b>	3.9±0.6	<b>&lt;0.001</b>	4.2±0.7	<b>&lt;0.001</b>	4.7±0.5	<b>&lt;0.001</b>	4.0±0.6	<b>&lt;0.001</b>
	No	2.7±0.6		3.1±0.6		3.1±0.7		4.3±0.5		3.1±0.5	
Diet for diabetes	Yes	3.8±0.9	<b>&lt;0.001</b>	3.9±0.6	<b>&lt;0.001</b>	4.2±0.7	<b>&lt;0.001</b>	4.7±0.5	0.053	4.0±0.6	<b>&lt;0.001</b>
	No	3.2±0.9		3.5±0.7		3.7±0.9		4.5±0.6		3.6±0.7	
Exercise for diabetes	Yes	3.8±0.9	<b>&lt;0.001</b>	3.9±0.6	<b>0.001</b>	4.3±0.7	<b>&lt;0.001</b>	4.7±0.5	0.080	4.0±0.6	<b>&lt;0.001</b>
	No	3.3±0.8		3.6±0.7		3.7±0.9		4.5±0.6		3.7±0.7	
Frequency of diabetes follow-up	Once every 3 months	3.8±1.0a	<b>&lt;0.001</b>	4.0±0.7a	<b>&lt;0.001</b>	4.3±0.7a	<b>&lt;0.001</b>	4.7±0.6a	<b>0.001</b>	4.1±0.7a	<b>&lt;0.001</b>
	Once every 6 months	3.8±0.8a		4.0±0.5a		4.3±0.7a		4.7±0.4a		4.0±0.5a	
	Once a year	3.5±0.8a		4.0±0.7b		3.7±0.9b		4.6±0.5a		3.7±0.7b	
	Irregular	3.0±0.8b		3.4±0.7b		3.4±1.0c		4.3±0.7b		3.4±0.7c	
Presentation to primary healthcare centers for diabetes follow-up	Yes	3.6±0.9	0.084	3.8±0.6	<b>0.019</b>	4.0±0.9	0.139	4.7±0.5	<b>0.041</b>	3.9±0.6	<b>0.025</b>
	No	3.4±0.9		3.6±0.7		3.8±0.9		4.5±0.6		3.7±0.7	
MMS level of motivation	Low	2.8±0.7	<b>&lt;0.001</b>	3.1±0.6	<b>&lt;0.001</b>	3.2±0.9	<b>&lt;0.001</b>	4.3±0.6	<b>&lt;0.001</b>	3.2±0.6	<b>&lt;0.001</b>
	High	3.8±0.8		4.0±0.5		4.3±0.7		4.7±0.5		4.1±0.5	
MMS level of knowledge	Low	2.7±0.7	<b>&lt;0.001</b>	3.1±0.6	<b>&lt;0.001</b>	3.1±0.8	<b>&lt;0.001</b>	4.3±0.6	<b>&lt;0.001</b>	3.2±0.5	<b>&lt;0.001</b>
	High	3.8±0.8		4.0±0.6		4.2±0.7		4.7±0.5		4.0±0.6	

a-c No significant difference between similar letters in categories in the same column

\*Independent samples t-test for two groups and ANOVA for groups of three or more

Positive correlations were observed between medication adherence motivation and knowledge scores and all DQOL scores (Table 3).

**Table 3:** Correlation analysis of medication adherence motivation/knowledge levels and the DQOL scale

	Total DQOL score	Satisfaction	Impact	Worry: diabetes related	Worry: social/vocational
Level of motivation	0.598*	0.505*	0.584*	0.552*	0.371*
Level of knowledge	0.602*	0.542*	0.567*	0.555*	0.329*

\*  $p < 0.01$ , Pearson correlation

The main effect of medication adherence motivation level was significant for all DQOL dimensions. The greatest effect of medication adherence motivation alone was on the psychological impact of the treatment dimension ( $\eta^2: 0.141$ ,  $p < 0.001$ ). The main effect of medication adherence knowledge was also significant for all the DQOL dimensions. The greatest effect of medication adherence knowledge levels alone was on the satisfaction with treatment dimension ( $\eta^2: 0.128$ ,  $p < 0.001$ ). The interaction effect of medication adherence motivation and medication knowledge levels on DQOL dimensions was only significant on satisfaction with treatment ( $\eta^2: 0.022$ ,  $p = 0.035$ ) (Table 4).

**Table 4:** Relation between medication adherence motivation and knowledge levels and quality of life

Factor	Scale scores	Type III Sum of Square	df	Mean Square	F	P*	$\eta^2$
Level of motivation	Satisfaction <sup>a</sup>	7.009	1	7.009	13.447	<0.001	0.062
	Impact <sup>b</sup>	9.563	1	9.563	33.523	<0.001	0.141
	Worry: diabetes related <sup>c</sup>	13.63	1	13.63	27.374	<0.001	0.118
	Worry: social/vocational <sup>d</sup>	2.795	1	2.795	9.901	0.002	0.046
Level of knowledge	Satisfaction	15.66	1	15.66	30.045	<0.001	0.128
	Impact	7.981	1	7.981	27.978	<0.001	0.120
	Worry: diabetes related	13.924	1	13.924	27.966	<0.001	0.120
	Worry: social/vocational	1.355	1	1.355	4.799	0.030	0.023
Level of motivation* Level of knowledge	Satisfaction	2.361	1	2.361	4.529	0.035	0.022
	Impact	0.007	1	0.007	0.025	0.875	0.000
	Worry: diabetes related	0.319	1	0.319	0.642	0.424	0.003
	Worry: social/vocational	0.379	1	0.379	1.343	0.248	0.007

<sup>a</sup> $R^2=0.353$ ; <sup>b</sup> $R^2=0.412$ ; <sup>c</sup> $R^2=0.381$ ; <sup>d</sup> $R^2=0.151$ ; (df: degree of freedom,  $\eta^2$ : Partial eta squared), \*MANOVA

## Discussion

Quality of life and treatment adherence are the most critical factors in the comprehensive care of patients with DM. Quality of life is regarded as an essential indicator of the course of the disease in DM.<sup>17</sup> Medication adherence can represent a significant problem in these patients.<sup>18</sup> Therefore, the evaluation of the quality of life and medication adherence of patients with DM has acquired considerable importance in recent years. This study investigated the relationship between quality of life and medication adherence in patients with type 2 DM receiving primary healthcare centers in the Turkish province of Samsun.

The great majority of the participants in this study used their diabetes medications regularly. Studies by Bradley et al. and Pinto et al. reported similar rates of patients with good medication adherence to those in the present research.<sup>19,20</sup> Jaam et al. reported that most patients with uncontrolled diabetes did not adhere to treatment in their study.<sup>12</sup> Trief et al. reported much poorer adherence to treatment among young adolescents diagnosed with type 2 diabetes than among adults.<sup>21</sup> In the present study, medication adherence was higher among participants education to high school level or above, who used diet and exercise for diabetes, and who had been informed about the disease.

The mean DQOL score in this study was higher than those reported by Akıncı et al. and Diriba et al.<sup>10,22</sup> This may be due to the different sociocultural levels in the regions where the studies were conducted. The lowest DQOL subscale score in this study was for satisfaction with treatment, and was similar to that in Akıncı et al.<sup>10</sup> The highest

DQOL score in this study was for social/vocational worry, and was similar to that reported by Diriba et al.<sup>22</sup> The lowest score being in the satisfaction with treatment dimension may be due to the majority of patients using OADs, to the lengthy and complex treatment process in diabetes, and to the difficulty in lifestyle modification and treatment adherence.

Married individuals in this study registered higher diabetes-related worry, social/vocational worry, and total DQO scores. The quality of life of married individuals was also observed to be higher in other studies.<sup>23,24</sup> The patients' quality of life in this study also increased in line with education levels and income levels. Essentially, quality of life was higher in patients with higher socioeconomic levels. Previous studies have also found that quality of life increases as education and income levels rise.<sup>17,22,24</sup> This may be due to patients with higher levels of education possessing greater information about their own disease and their therapeutic regimens.

In this study, 54.5% of patients went to health care facilities other than primary care for diabetes follow-up. This may be due to the fact that some OADs and most insulins cannot be reported by primary care physicians in our country. Another reason for this may be that patients in Turkiye have easy access to physicians in the secondary and tertiary care settings because they are free to apply to any institution they want.

Patients with type 2 DM diagnosed less than five years previously had better quality of life scores, with the exception of the social/vocational worry subdimension. Other studies have also shown that quality of life declines with the duration of diabetes.<sup>20,24</sup> The absence of any difference in the social/vocational worry subdimension depending on the duration of diabetes may be attributable to a large proportion of participants being married, with children, retired, or homemakers. All DQOL scores were lower among patients with type 2 DM-related complications. Other studies have also found that the presence of complications has an adverse effect on the quality of life.<sup>10,24</sup> With the exception of the social/vocational worry subdimension, all DQOL scores were significantly higher among patients using diet and exercise for their diabetes. Other studies have also reported a higher quality of life among dieters and exercisers.<sup>17,25,26</sup> This may be due to diabetes-related symptoms and complications emerging less or later among patients with good adherence to lifestyle modifications. Akyol et al. found that there was a negative significant correlation between nutritional literacy individuals with diabetes. This situation may decrease the quality of life with poor diet in societies with low sociocultural level.<sup>27</sup> Thomas et al. found the diet quality of type 2 diabetes patients to be very poor and reported that a diet suitable for their socioeconomic level should be recommended in primary care.<sup>28</sup>

Quality of life also varied in terms of the treatment regimens employed for diabetes. The quality of life was significantly higher in patients using OADs alone than in those using OADs and insulin in combination or insulin alone. However, no significant difference in quality of life was determined between patients using a combination of OADs and insulin and those using only insulin. Akıncı et al. reported lower quality of life in patients receiving insulin therapy.<sup>10</sup> In Kumar et al.'s study, the quality of life of patients receiving an OAD regimen only was significantly higher than in those receiving a combination of OADs and insulin.<sup>25</sup> Similarly to the present study, Yumin et al. and Timar et al. also reported lower quality of life in patients receiving insulin therapy.<sup>26,29</sup> This may be due to the development of local complications in the insulin injection site, the hypoglycemia side-effect of insulin, and pain associated with insulin injection.

The quality of life in this study was higher among participants with higher medication adherence motivation and knowledge according to the MMS. A positive correlation was found between medication adherence motivation, knowledge level, and all the DQOL scores. However, the interaction effect of medication adherence motivation and knowledge levels only impacted on the satisfaction with the treatment DQOL dimension. In other words, medication adherence had no impact on the psychological effect or anxiety aspects of quality of life. Our literature review revealed no studies investigating medication adherence in patients with type 2 DM using the six-question MMS. In a study using the DAI-10 scale, Majeed et al. reported an association between good quality of life and better medication adherence in patients with type 2 DM.<sup>30</sup> Khayyat et al. investigated patients with hypertension and diabetes in primary care using the WHOQOL-BREF and MMAS-8 scales and observed better quality of life in individuals with high medication adherence.<sup>5</sup> Honish et al. found that quality of life increased in line with treatment adherence.<sup>31</sup> In a study employing the BMQ scale, Perwitasari et al. reported a positive correlation between medication adherence and quality of life in patients with type 2 diabetes.<sup>32</sup> Although medication adherence had an impact on satisfaction with the treatment dimension of quality of life, it had no effect on the psychological impact or worry dimensions. The biopsychosocial approach model of family medicine permits comprehensive diabetes patient management for the quality of life, psychological impact, and anxiety dimensions of diabetes patients. Comprehensive diabetes management in primary care provides an opportunity to evaluate the quality of life from different perspectives.

There are a number of limitations to this study. The first is that the data were collected only from individuals presenting to two E-FHCs in Samsun. The results may, therefore, only be representative of some of the Turkish population. A second limitation is that evaluation of quality of life was performed entirely within the scope of the

DQOL scale. A third limitation is that questions concerning the treatment and management of diabetes were restricted to patients' self-reports. In the present study, complications and medication adherence were discussed, but metabolic parameters (haemoglobin A1C, fasting blood glucose, body mass index and lipid parameters) were not included. The strength of this study is that our literature search revealed no previous studies evaluating the relationship between quality of life and medication adherence in patients with type 2 DM using the DQOL scale and MMS.

### Conclusion

In conclusion, according to the results of our study on diabetic patients, it was found that drug compliance and quality of life were better in those with higher education levels, those with good socioeconomic status, those who had diet and exercise, those with low complication rates, and those who only used OAD. Since diabetes is a chronic disease with continuity, it requires constant care. Therefore, it can be followed more closely with continuous care in family medicine. There are multiple factors affecting the quality of life of diabetic patients, and it is more appropriate to follow up with a person-centered approach rather than a disease-centered approach. Continuous follow-up of diabetic patients in primary care, where patient follow-up is carried out with a biopsychosocial approach, can improve drug compliance and quality of life of patients.

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### Conflicts of Interest

The authors declare that they have no competing interests.

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