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The Effect of Treatment Adherence on Risk Perception of Complications and Metabolic Control in Patients with Type 2 Diabetes

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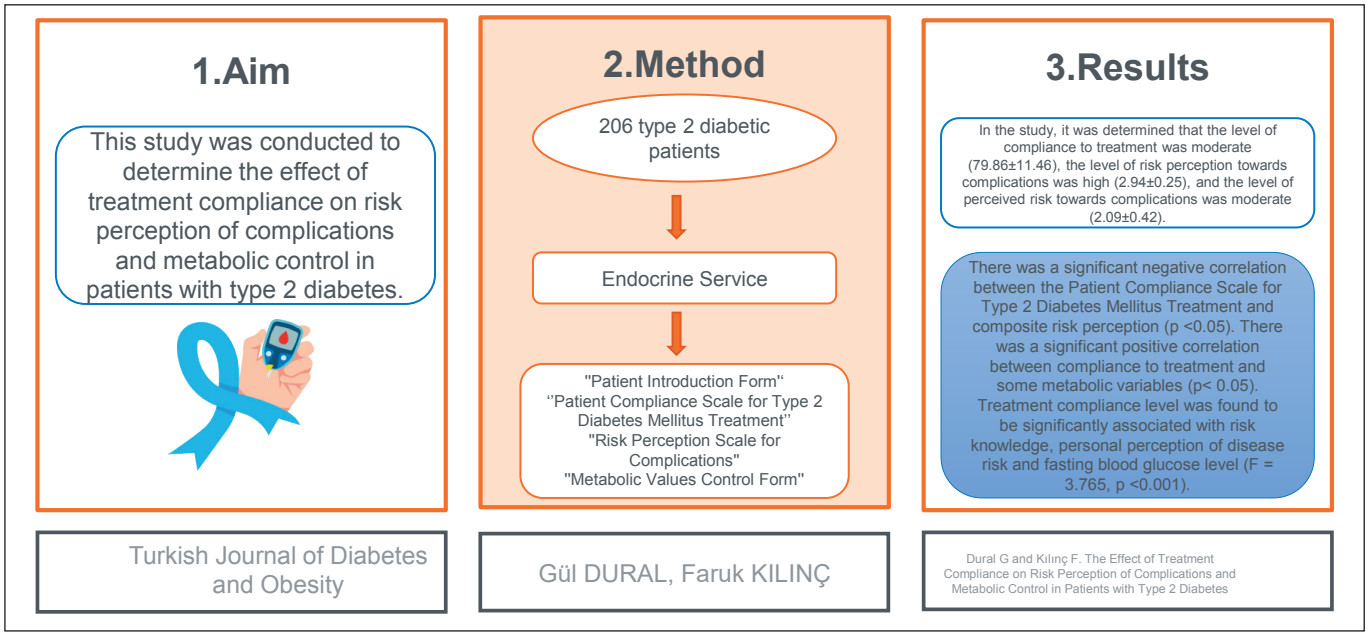
GRAPHICAL ABSTRACT



ABSTRACT

Aim: This study was conducted to determine the effect of treatment compliance on risk perception of complications and metabolic control in patients with type 2 diabetes.

Material and Methods: The sample of this descriptive study consisted of 206 type 2 diabetic patients aged 18 years and older who were hospitalized October 2023 and March 2024 and who volunteered to participate in the study. In the collection of the study data, the "Patient Introduction Form", which includes the descriptive characteristics of the patients, "Patient Compliance Scale for Type 2 Diabetes Mellitus Treatment", "Risk Perception Scale for Complications" and "Metabolic Values Control Form" were used. Descriptive statistics and correlation statistical analysis methods were used in the evaluation.

Results: In the study, it was determined that the level of compliance to treatment was moderate (79.86±11.46), the level of risk perception towards complications was high (2.94±0.25), and the level of perceived risk towards complications was moderate (2.09±0.42). There was a significant negative correlation between the Patient Compliance Scale for Type 2 Diabetes Mellitus Treatment and composite risk

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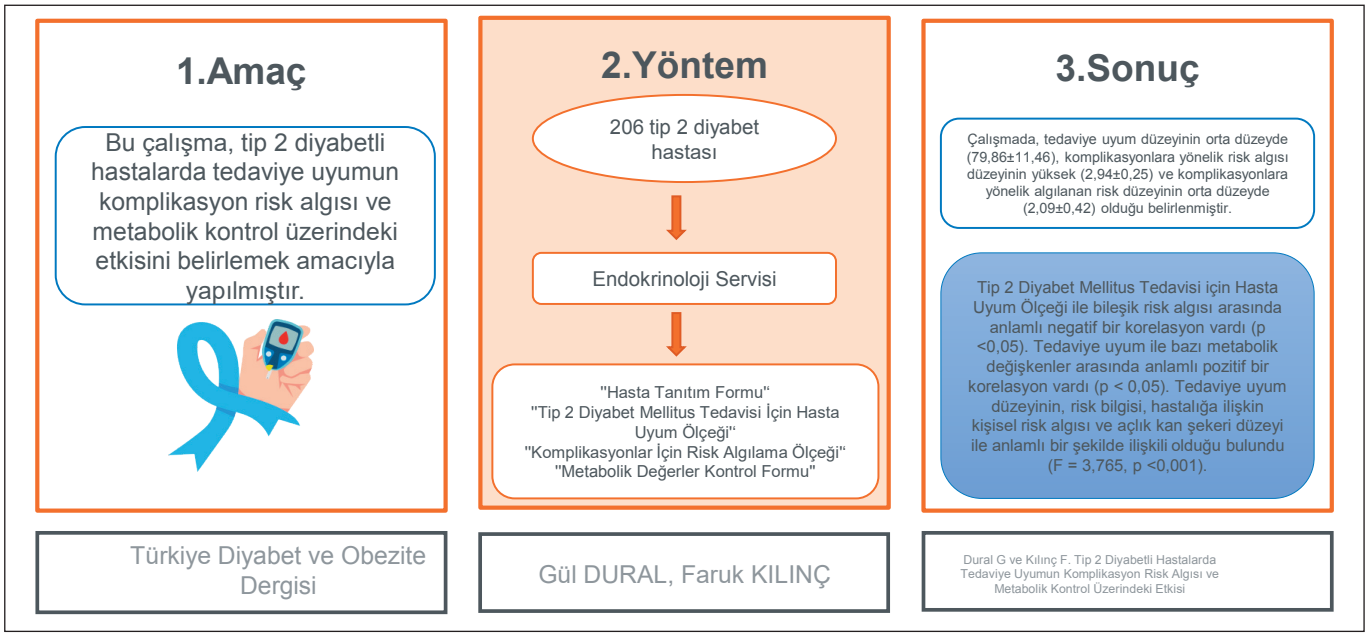
perception (p <0.05). There was a significant positive correlation between compliance to treatment and some metabolic variables (p< 0.05). Treatment compliance level was found to be significantly associated with risk knowledge, personal perception of disease risk and fasting blood glucose level (F = 3.765, p <0.001).

Conclusion: In this study, it was found that the level of compliance to treatment significantly predicted fasting blood glucose level in individuals with type 2 diabetes along with risk knowledge and personal disease risk among risk perception components. However, other risk perception dimensions and most of the metabolic variables had no significant effect on treatment compliance. These findings suggest that individuals' disease knowledge and risk perceptions are important factors affecting their treatment compliance behaviors.

Keywords: *Metabolic control, Risk perception, Treatment compliance, Type 2 diabetes*

Tip 2 Diyabetli Hastalarda Tedaviye Uyumun Komplikasyon Riski Algısı ve Metabolik Kontrol Üzerindeki Etkisi

GRAFİKSEL ÖZET



ÖZ

Amaç: Bu çalışma tip 2 diyabetli hastalarda tedaviye uyumun komplikasyonlara ilişkin risk algısı ve metabolik kontrole etkisinin belirlenmesi amacıyla yapılmıştır.

Gereç ve Yöntemler: Tanımlayıcı tipteki bu araştırmanın örneklemini Fırat Üniversitesi Hastanesi'nde Ekim 2023-Mart 2024 tarihleri arasında Endokrin Servisinde yatarak tedavi gören, çalışmaya katılmaya gönüllü, 18 yaş ve üstü 206 tip 2 diyabetli hasta oluşturmuştur. Çalışma verilerinin toplanmasında hastaların tanıtıcı özelliklerini içeren "Hasta Tanıtım Formu", "Tip 2 Diabetes Mellitus Tedavisine Hasta Uyum Ölçeği", "Komplikasyonlara İlişkin Risk Algısı Ölçeği" ve "Metabolik Değerler Kontrol Formu" kullanılmıştır. Değerlendirmede tanımlayıcı istatistikler ve Korelasyon istatistik analiz yöntemleri kullanılmıştır.

Bulgular: Araştırmada hastaların tedaviye uyum düzeyinin orta (79,86±11,46), komplikasyonlara yönelik risk algısı düzeyinin yüksek (2,94±0.25), komplikasyonlara yönelik algılanan risk düzeyinin orta (2.09±0,42) düzeyde olduğu belirlenmiştir. Tip 2 Diabetes Mellitus Tedavisine Hasta Uyum Ölçeği ile bileşik risk algısı arasında negatif yönde anlamlı ilişki olduğu görülmüştür (p< 0.05). Tedaviye uyum ile bazı metabolik değişkenler arasında pozitif yönde anlamlı ilişki olduğu görülmüştür (p< 0.05). Tedaviye uyum düzeyinin risk bilgisi, kişisel hastalık riski algısı ve açlık kan şekeri düzeyi ile anlamlı şekilde ilişkili olduğu bulunmuştur (F = 3.765, p = 0.000).

Sonuç: Bu çalışmada, tip 2 diyabetli bireylerde tedaviye uyum düzeyinin; risk algısı bileşenlerinden risk bilgisi ve kişisel hastalık riski ile birlikte açlık kan şekeri düzeyini anlamlı şekilde yordadığı bulunmuştur. Buna karşın diğer risk algısı boyutları ve metabolik değişkenlerin çoğunun tedaviye uyum üzerinde anlamlı bir etkisi saptanmamıştır. Bu bulgular, bireylerin hastalıkla ilgili bilgi ve risk algılarının, tedaviye uyum davranışlarını etkileyen önemli faktörler olduğunu göstermektedir.

Anahtar Sözcükler: *Metabolik kontrol, Risk algısı, Tedaviye uyum, Tip 2 diyabet*

INTRODUCTION

Type 2 diabetes mellitus (T2DM) represents a major global health concern, with a rapidly increasing prevalence worldwide (1,2). According to the International Diabetes Federation 2021 data, there are 589 million patients with T2DM worldwide. This number is projected to reach 853 million in 2050 (3) According to the results of the TURDEP-II study conducted in our country, there are approximately seven million diabetic patients (4).

Complications of T2DM, which has complications such as heart diseases, stroke, diabetic retinopathy, kidney diseases and organ amputations, can be prevented with appropriate treatment, control and care (1,5). The occurrence of complications in diabetes is a global problem (6). Patients experiencing complications are less motivated for treatment, are unable to make medical visits, and as a result, their treatment compliance decreases (1).

Treatment compliance includes behaviors that enable patients to manage their diseases effectively and reduce the severity and complications of the disease. Patients need to regulate their health behaviors in order to control their disease (7). These lifestyle changes include weight control, physical activity, diet and compliance to medication (8). It has been observed that up to 40% of diabetic patients do not adhere to treatment (9). Most people with chronic disease experience non-compliance to treatment (7). If treatment compliance is ensured in diabetic patients, there is a decrease in acute complications and a delay in the occurrence of chronic complications (10).

Perceived health-related risks among individuals living with T2DM are important in their compliance with treatment. Sometimes patients' risk perception may affect their health behaviors. If patients have a positive risk perception towards he onset and progression of the disease and its associated complications, their nutrition, exercise, medication compliance and self-care can be positively affected. Risk perception regarding diabetes complications reflects individuals' understanding of the potential complications arising from the disease (11). Patients should increase their patients' awareness and understanding of potential complications and ensure their compliance with treatment (12). Most of the complications arising due to diabetes are the lack of compliance with treatment due to ineffective management of the disease (6). Previous research indicates that risk perception of diabetes patients towards complications is at a moderate level and most of the patients are worried about experiencing complications (6,12).

It is known that compliance with treatment is associated with metabolic control in T2DM patients. Studies have shown that as compliance to treatment decreases, HbA1c (Glycated Hemoglobin) level increases, and as metabolic control increases, diabetes complications such as cardiovascular and renal diseases are prevented (13).

In this context, it was thought that the complication risk perception and metabolic control levels of patients should be examined first for treatment compliance in T2DM patients, so this study was planned. The primary objective of this study was to investigate the impact of treatment compliance on metabolic control and the perception of complication risks among patients with Type 2 Diabetes Mellitus.

MATERIAL and METHODS

This descriptive research was carried out in the endocrinology clinic of a university hospital from October 2023 to March 2024. The study received ethical clearance from the Non-Interventional Ethics Committee of Fırat University (Approval no: 2023/ 08- 27). Ethical approval for this study was obtained from the Interventional Ethics Committee (Approval No. 2023/08-27). Prior to participation, all individuals received detailed information regarding the purpose and procedures of the study.

Population and Sample

The target population of the research included patients with Type 2 Diabetes Mellitus (T2DM) who were hospitalized in the endocrinology clinic of a university hospital. The study sample was comprised of volunteers from this unit who fulfilled the eligibility criteria. Participants were selected using the convenience sampling technique.The G-Power program was used to calculate the sample size with an effect size of 0.6, 95% power, and a margin of error of 0.05, resulting in a sample size of 206 patients with T2DM. Research data were collected from October 2023 to March 2024.

The study included individuals aged 18 years and older who had been diagnosed with T2DM at least six months prior, could communicate in Turkish, and were able to provide informed consent. Participants had to be clinically stable and able to actively participate in the data collection process. Patients with acute or severe diabetes complications (e.g., diabetic ketoacidosis, hyperosmolar hyperglycemic state, an active diabetic foot ulcer, or a condition requiring hospitalization due to an acute infection) were excluded from the study.However, individuals with mild or chronic, stable complications such as retinopathy, neuropathy, or nephropathy whose conditions were under medical control were not excluded as long as these conditions did not prevent participation.Individuals with type 1 diabetes, serious systemic diseases, cognitive impairments, or psychiatric disorders that could prevent them from completing the questionnaires were also excluded.

Data were collected through face-to-face interviews using the Case Repost Form, Patient Compliance Scale for Type 2 DM Treatment, Risk Perception Scale-DM (RPS-DM) and Metabolic Control values.

Case Repost Form: This form is a structured tool that collects information on participants' demographics, clinical characteristics, and lifestyles. The form contains sociodemographic variables such as gender, educational level, employment status, and economic status. Additionally, the form assesses the participant's diabetes treatment method, regular blood glucose monitoring, regular exercise, regular health check-ups, presence of acute and chronic complications, and whether the participant received education about the disease. Anthropometric evaluation included classifying body mass index (BMI) as underweight, normal weight, overweight, or obese (class I–III). Age was recorded in years and presented as the mean ± standard deviation (SD) and minimum–maximum values.

Patient Compliance Scale for Type 2 DM Treatment: This scale was developed by Demirtaş and Albayrak. The scale yields a total score ranging between 30 and 150. A low score on the scale indicates that type 2 DM patients have good treatment compliance. Scale interpretation was based on total score values. Total scores of 30–54 (0–20%) were interpreted as good treatment adherence, scores of 55–125 (20–80%) as moderate adherence, and scores of 126–150 (80–100%) as poor adherence. The scale yields a minimum possible score of 30 and a maximum possible score of 150. The Cronbach's alpha coefficient is 0.77 (14). In this study, Cronbach's alpha coefficient was 0.62.

Risk Perception Scale- Diabetes Mellitus (RPS-DM): The scale was developed by Elizabeth A. Walker in 2007 and tested for validity and reliability (15). It is the first instrument to measure knowledge about diabetes complications and risk perception. The Turkish adaptation, including validity and reliability testing, was performed by Taskın Yılmaz et al. (2018) for adults aged 18 and over diagnosed with Type 1 or Type 2 diabetes. While the original Turkish version reported Cronbach's alpha coefficients between 0.76 and 0.92 (16), the current study calculated the Cronbach's alpha as 0.79 for the total scale and 0.65 for the risk knowledge subscale.

Metabolic Control Values: he form recorded key physiological parameters categorized as: anthropometric measurements Body Mass Index (kg/m^2); glycemic control indicators (fasting blood glucose, postprandial blood glucose, HbA1c (%); hemodynamic values (systolic and diastolic blood pressure (mmHg); and a full lipid profile (total cholesterol, triglycerides, HDL, and LDL cholesterol (mg/dL) Metabolic target control values include the values checked in the last three months during routine controls of the patients.

Statistical Analyses

The threshold for statistical significance was established as a p-value of <0.05 for data analysis. The study presented descriptive data through means, standard deviations, frequencies, and percentages. To verify the normality of the distribution, skewness and kurtosis values were examined. The relationships between treatment adherence, perception of complication risk, and metabolic control indicators were investigated using Pearson's correlation test. Furthermore, a multiple regression model was employed to determine the predictive impact of independent variables on the dependent variable.

RESULTS

Of the patients who participated in the study, 56.8% were female, mean age was 59.07±12.51 years, 66.5% were primary school graduates, 67.5% were unemployed, 68.9% had a middle income, 89.3% used insulin with oral antidiabetics, 72.3% measured blood glucose levels regularly, 57.3% exercised regularly, 59.7% did not go for regular health check-ups, 81.6% had additional chronic diseases, 75.7% had acute and 57.3% had chronic diseases. 3% exercised regularly, 59.7% did not go for regular health check-ups, 81.6% had additional chronic diseases, 75.7% experienced acute and 57.8% chronic complications, 84% received education about their disease (Table 1).

Cronbach's alpha coefficient was calculated to evaluate the internal consistency of the Patient Compliance Scale for Type 2 DM Treatment. While the original study reported a coefficient of 0.77 (14), the present study yielded a Cronbach's alpha value of 0.62.

The Cronbach's alpha coefficients for the total scale of the Turkish version of the Diabetes Mellitus Risk Perception Scale (RPS-DM) ranged from 0.76 to 0.92 (16). In this study, the Cronbach's alpha coefficient was calculated as 0.65 for the risk knowledge subscale and 0.79 for the total scale. Cronbach's alpha values were found to be 0.64 for the anxiety subscale, 0.67 for the optimism subscale, 0.74 for the personal disease risk subscale, and 0.80 for the environmental risk subscale under the composite risk perception subscale.

In Table 2, the mean scores of the sub-dimensions of the Patient Compliance Scale for Type 2 DM Treatment are as follows: attitudes and emotional factors 22.81±4.39, knowledge and personal factors 16.34±5.43, lifestyle change 10.08±3.47, feelings of anger 7.67±2.43, adaptive emotions and behaviors 7.62±3.24, diet bargaining 9.57±2.45, denial bargaining 5.73±2.96 and the mean total score of the scale was 79.86±11.46. Diabetes Mellitus-Risk Perception Scale subscale mean scores were calculated as risk knowledge 2.85±0.28, composite risk knowledge 2.10±0.42, anx-

Table 1. Descriptive characteristics of patients

Demographic Variables*	Findings (n=206)	
Gender		
Male	89	(43.2)
Female	117	(56.8)
Educational status		
Primary School	137	(66.5)
Middle School	29	(14.1)
High school	22	(10.7)
University and higher	18	(8.7)
Working status		
Yes	139	(67.5)
No	67	(32.5)
Economic status		
Income<expenses	38	(18.4)
Income=expenses	142	(68.9)
Income>expenses	26	(12.6)
The way diabetes is treated		
Oral antidiabetics (OA)	22	(10.7)
OA+Insulin	184	(89.3)
Regular blood glucose monitoring		
Yes	149	(72.3)
No	57	(27.7)
Regular exercise		
Yes	118	(57.3)
No	88	(42.7)
Regular health check-ups		
Yes	83	(40.3)
No	123	(59.7)
Acute complications		
Yes	156	(75.7)
No	50	(24.3)
Chronic complications		
Yes	119	(57.3)
No	87	(42.2)
Receiving education about the disease		
Yes	173	(84.0)
No	33	(16.0)
Body mass index		
Underweight (<18.5 kg/m^2)	7	(3.4)
Normal (18.5-24.9 kg/m^2)	68	(33.0)
Overweight (25-29.9 kg/m^2)	53	(25.7)
1st degree obese (30-34.9 kg/m^2)	47	(22.8)
Grade 2 obese (35-39.9 kg/m^2)	14	(6.8)
Grade 3 obese (>40 kg/m^2)	17	(8.3)
Age (year±SD,(minimum-maximum)	59.0 ±12.51	(24-86)

*Data are shown as number, and percentage (%).

Table 2. Individuals' Diabetes Mellitus-Risk Perception and Diabetes Health Promotion Self-Care Scale Subscale and Total Scores

Variables*	Findings (n=206)	
The Scale for Compliance to the Treatment in Type 2 Diabetes Mellitus		
Attitude and emotional factor	22.81±4.39	(8-34)
Knowledge and personal factors	16.34±5.43	(7-30)
Lifestyle changes	10.08±3.47	(3-15)
Feelings of anger	7.67±2.43	(3-15)
Adaptive emotions and behaviors	7.62±3.24	(4-16)
Diet negotiation	9.57±2.45	(3-15)
Denial Bargaining	5.73±2.96	3-14
Total score	79.86±11.46	53-111
The Risk Perception Survey–Diabetes Mellitus (RPS-DM) Scale		
Risk Knowledge	2.85±0.28	0-3
Composite Risk Perception	2.10±0.42	1.32-3.55
Worry	1.91±0.63	1-4
Optimistic	3.02±0.49	1-4
Personal Disease Risk	2.22±0.63	1-4
Environmental Risk	1.83±0.56	1-4
Metabolic Variables		
Fasting blood glucose (mg/dL)	198.67±87.15	69-511
Postprandial blood glucose (mg/dL)	216.16±97.69	73-522
HbA1c (%)	10.74±2.99	4.90-19.80
HDL (mg/dL)	43.12±16.50	22-154
LDL (mg/dL)	125.21±45.20	19-335
Triglyceride (mg/dL)	212.97±148.61	26-753

*Data are shown as mean ±standart devation (minimum-maximum).

iety 1.91±0.63, optimism 3.02±0.49, personal disease risk 2.22±0.63, environmental risk 1.83±0.56, and total mean score 2.94±0.25. The mean scores of metabolic variables of the patients were 198.67±87.15 for fasting blood glucose, 216.16±97.69 for postprandial blood glucose, 10.74±2.99 for HbA1c, 43.12±16.50 for HDL, 125.21±45.20 for LDL, 212.97±148.61 for triglyceride, and 28.58±6.52 for BMI.

The total scores of patients on the Patient Compliance Scale for Type 2 DM Treatment and the subscale scores of the Diabetes Mellitus Risk Perception Scale, including risk knowledge, composite risk knowledge, anxiety, optimism, personal disease risk, and environmental risk, were compared according to sociodemographic characteristics and are presented in Table 3. The mean score on the Patient Compliance Scale for Type 2 DM Treatment was found to

be statistically significant ($p < 0.05$) in relation to regular blood sugar measurements and disease-specific education (Table 3).

The mean score of the Diabetes Mellitus Risk Perception Scale Risk Knowledge subscale was found to be statistically significant in relation to education, employment status, regular blood sugar measurement, presence of chronic complications, presence of additional chronic diseases, and receiving education about the disease. The composite risk knowledge subscale score average differed significantly ($p<0.05$) according to employment status, income status, regular blood sugar measurement, and regular health check-ups. A statistically significant variation was found in the mean anxiety subscale scores depending on the presence of chronic complications ($p < 0.05$). Similarly, the mean scores of the optimism subscale differed significantly based on education level, income status, physical activity habits, chronic complications, comorbidities, and body mass index ($p < 0.05$). The difference in the average personal disease risk subscale score and the variables of education, employment status, income status, diabetes treatment method, regular blood sugar measurement, regular health checkups, chronic complications, and additional chronic diseases was also statistically significant ($p < 0.05$). It was found that the difference between the environmental risk sub-dimension score average and gender, income status, regular blood sugar measurement, and regular health checkups was statistically significant ($p<0.05$) (Table 3).

The results of the correlation analysis conducted to examine the relationship between patients' treatment compliance and risk perception scales mean scores are presented in Table 4. Correlation strength was evaluated as weak, moderate or strong.

A weak negative correlation was found between patients' treatment compliance scores and their risk knowledge mean scores ($p<0.05$), a weak negative correlation was found between composite risk knowledge mean scores ($p<0.01$), and a weak negative relationship between the environmental risk score average ($p<0.01$). No statistically significant relationship was found between patients' treatment compliance and anxiety, optimism, and personal disease risk score averages ($p>0.05$) (Table 4).

The results of the correlation analysis conducted to examine the relationship between patients' mean scores of treatment compliance and metabolic control variables are presented in Table 5. Correlation strength was evaluated as weak (0.10–0.29), moderate (0.30–0.49), or strong (0.50–1).

A weak positive correlation ($p<0.01$) was found between patients' traetment compliance scores and fasting blood sugar levels, a weak positive correlation ($p<0.01$) between patients' type 2 diabetes mellitus treatment compliance scale scores and postprandial blood sugar scores, HbA1c score average ($p<0.01$). No statistically significant associations were identified between the type 2 diabetes mellitus treatment adherence scale and mean HDL, LDL, and triglyceride levels ($p > 0.05$) (Table 5).

The results of the regression analysis, which was conducted to interpret the effect of treatment compliance on risk perception and metabolic variables, are presented in Table 6. The model established to test the extent to which the dependent variable, the " Patient Compliance Scale for Type 2 DM Treatment," explained the independent variables, the "Diabetes Mellitus Risk Perception Scale" and "Metabolic Variables," was found to be statistically significant as a whole ($F = 3.765$, $p = <0.001$) (Table 6).

A multiple linear regression analysis was performed to identify variables that predict treatment compliance in individuals with diabetes mellitus. The model was found to be significant overall ($R = 0.630$, $R^2 = 0.397$, $F = 3.765$, $p < 0.001$) and explained approximately 39.7% of the variance in the dependent variable.

According to the results of the analysis, the variables that significantly affected treatment compliance were fasting blood glucose (FBG) and risk knowledge (RK). The coefficient for the FBG variable is positive and significant ($B = 0.047$, $p = 0.006$, 95% CI [0.014–0.081]), indicating that treatment compliance scores increase as fasting blood sugar levels rise.

Conversely, the RK variable's coefficient was negative and significant ($B = -13.414$, $p = 0.008$, 95% CI [-23.121, -3.708]). This indicates that treatment compliance scores decrease as participants' risk knowledge increases (Table 6).

The model showed no significant effects for the other variables: fasting blood sugar (FBS), HbA1c, HDL, LDL, triglycerides, anxiety, optimism, personal disease risk, and environmental risk variables ($p > 0.05$).

DISCUSSION

The results of the study, which evaluated the effect of treatment compliance on complication risk perception and metabolic control in patients with T2DM, reveal that treatment compliance plays a critical role in these factors. While the findings are generally consistent with existing literature, they also reveal some differences.

This study found that the Cronbach's alpha coefficient of the Patient Compliance Scale for Type 2 DM Treatment was

Table 3. Distribution of Patient Compliance to Type 2 Diabetes Mellitus Treatment Scale and Diabetes Mellitus-Risk Perception Scale Scale Scores According to the Descriptive Characteristics of the Patients (n=206)

Variables (x±SD)		T2DTCS	Risk Knowledge	Composite Risk Perception	Worry	Optimistic	Personal Disease Risk	Environmental Risk
		(x±SD)	(x±SD)	(x±SD)	(x±SD)	(x±SD)	(x±SD)	
Gender	Female	79.49±11.71	2.85±0.26	2.15±0.41	1.86±0.63	3.05±0.42	2.25±0.58	1.92±0.55
	Male	80.34±11.17	2.84±0.30	2.04±0.44	1.93±0.62	2.99±0.57	2.18±0.70	1.72±0.56
	t	-0.528	0.209	1.833	-0.507	0.814	0.797	2.474
	p	0.598	0.835	0.068	0.613	0.417	0.427	**0.014**
Education Status	Primary School	79.45±11.19	2.87±0.27	2.15±0.39	1.86±0.62	3.10±0.45	2.33±0.57	1.81±0.52
	Middle School	82.27±11.34	2.89±0.22	1.95±0.40	1.89±0.47	2.89±0.43	2.01±0.62	1.70±0.59
	High school	77.72±10.96	2.74±0.28	2.06±0.51	2.20±0.67	2.93±0.49	1.98±0.71	1.91±0.64
	University and higher	81.72±14.16	2.70±0.30	2.10±0.55	1.97±0.77	2.71±0.71	1.96±0.78	2.12±0.61
	F	0.897	3.578	1.729	1.963	4.131	4.772	2.365
	p	0.444	**0.015**	0.162	0.121	**0.007**	**0.003**	0.072
Working status	Yes	80.94±11.41	2.77±0.34	2.02±0.42	1.92±0.59	3.02±0.52	2.03±0.69	1.81±0.56
	No	79.34±11.49	2.88±0.23	2.15±0.42	1.90±0.64	3.02±0.44	2.31±0.58	1.84±0.56
	t	-0.935	2.708	2.004	-0.201	0.086	3.059	0.335
	p	0.351	0.007	0.046	0.841	0.931	0.003	0.738
Economic status	Income<expenses	80.68±10.14	2.87±0.25	2.03±0.34	1.72±0.69	3.21±0.54	2.13±0.55	1.73±0.48
	Income=expenses	79.63±11.56	2.83±0.29	2.17±0.43	1.96±0.59	2.97±0.49	2.32±0.64	1.90±0.57
	Income>expenses	79.92±13.03	2.88±0.24	1.86±0.39	1.98±0.68	3.05±0.40	1.82±0.51	1.63±0.55
	F	0.125	0.503	6.879	2.158	3.607	7.611	3.292
	p	0.882	0.606	**0.001**	0.118	**0.029**	**0.001**	**0.039**
The way diabetes is treated	Oral antidiabetics (OA))	78.77±14.93	2.83±0.24	2.02±0.32	1.90±0.52	3.13±0.46	2.25±0.47	1.87±0.56
	OA+insülin	79.99±11.02	2.85±0.28	2.12±0.43	1.91±0.64	3.01±0.49	1.87±0.64	1.83±0.56
	t	-0.471**	-0.315**	-1.011**	-0.028**	1.096**	-2.193*	0.371**
Regular blood glucose monitoring	Yes	76.85±10.48	2.85±0.28	2.19±0.43	1.90±0.62	2.98±0.52	2.35±0.61	1.91±0.59
	No	87.71±10.20	2.85±0.27	1.89±0.32	1.92±0.66	3.12±0.41	1.88±0.55	1.62±0.41
	t	-6.701	-0.084	4.712	-0.118	-1.725	5.049	3.374
	p	**0.000**	**0.933**	**0.000**	0.906	0.086	**0.000**	**0.001**

Table 3. Continued

Don't skip regular exercise	Yes	79.16±11.73	2.86±0.25	2.09±0.40	1.94±0.59	2.96±0.50	2.20±0.62	1.82±0.55
	No	80.79±11.09	2.82±0.30	2.13±0.46	1.86±0.67	3.11±0.47	2.24±0.65	1.85±0.60
	t	1.007	-0.995	0.624	-0.963	2.189	0.456	0.456
	p	0.315	0.341	0.533	0.337	**0.030**	0.649	0.649
Regular health check-ups	Yes	74.24±9.30	2.88±0.27	2.24±0.40	1.87±0.56	3.00±0.47	2.39±0.59	2.01±0.57
	No	83.65±11.25	2.82±0.28	2.01±0.41	1.93±0.67	3.04±0.51	2.10±0.63	1.71±0.52
	t	-6.304	1.537	3.957	-0.731	-0.490	3.294	3.853
	p	**0.000**	0.126	**0.000**	0.466	0.625	**0.001**	**0.000**
Having Acute Complications	Yes	80.58±11.72	2.85±0.26	2.09±0.44	1.89±0.58	3.02±0.47	2.21±0.61	1.82±0.58
	No	77.62±10.42	2.84±0.33	2.14±0.38	1.97±0.76	3.04±0.57	2.25±0.69	1.88±0.48
	t	1.596	0.129	-0.698	-0.739	-0.217	-0.390	-0.626
	p	0.112	0.897	0.486	0.461	0.828	0.697	0.532
Having Chronic Complications	Yes	80.88±10.97	2.88±0.27	2.15±0.41	1.81±0.66	3.09±0.47	2.37±0.59	1.79±0.57
	No	78.47±12.02	2.80±0.28	2.05±0.43	2.04±0.55	2.93±0.51	2.01±0.63	1.89±0.55
	t	1.495**	2.831*	1.719**	-2.517*	2.243*	4.245*	-1.253**
Having additional chronic diseases	Yes	79.70±11.62	2.87±0.25	2.13±0.42	1.88±0.61	3.07±0.44	2.27±0.60	1.84±0.56
	No	80.57±10.86	2.73±0.36	1.99±0.43	2.02±0.68	2.80±0.63	2.00±0.70	1.80±0.55
	t	-0.425	2.831	1.801	-1.233	3.145	2.355	0.393
	p	0.672	**0.005**	0.073	0.219	**0.005**	**0.019**	0.695
Receiving education about the disease	Yes	78.61±10.94	2.88±0.24	2.08±0.39	1.91±0.60	3.03±0.47	2.20±0.59	1.79±0.51
	No	86.39±12.07	2.66±0.36	2.23±0.57	1.89±0.76	2.98±0.61	2.34±0.80	2.04±0.73
	t	-3.677	4.298	-1.859	0.185	0.527	-1.158	-2.292
	p	**0.000**	**0.000**	0.064	0.853	0.599	0248	**0.023**
Body Mass Index (kg/m²)	Weak	83.14±8.98	2.90±0.25	1.82±0.39	2.00±0.00	2.57±0.78	1.82±0.55	1.61±0.62
	Normal	79.19±13.30	2.84±0.26	2.07±0.43	1.88±0.52	2.94±0.43	2.11±0.64	1.89±0.58
	Overweight	77.62±8.02	2.80±0.32	2.21±0.47	1.76±0.59	3.21±0.48	2.34±0.57	1.96±0.61
	1st degree obese	81.59±12.73	2.86±0.30	2.04±0.43	2.02±0.72	2.93±0.51	2.21±0.77	1.67±0.48
	2nd degree obese	78.57±10.93	2.88±0.21	2.07±0.43	1.82±0.63	3.17±0.57	2.23±0.56	1.73±0.49
	3rd degree obese	84.47±9.18	2.92±0.14	2.23±0.31	2.23±0.84	3.05±0.24	2.44±0.32	1.83±0.47
	F	1.377**	0.604**	1.882**	1.918**	3.915*	1.747**	1.781**

SD = Standard deviation; *p < 0.05. **p>0.05 was considered statistically significant.

Tablo 4. Examination of the relationship between the Patient Compliance Scale for Type 2 Diabetes Mellitus Treatment and the Diabetes Mellitus Risk Perception Scale subscale mean scores (n=206)

Variables	1	2	3	4	5	6	7
Risk Knowledge	—						
Composite Risk Perception	-.123	—					
Worry	-.134	.199**	—				
Optimistic	.180**	.084	-.218**	—			
Personal Disease Risk	.016	.864**	.085	.055	—		
Enviromental Risk	-.248**	.812**	.066	-.047	.440**	—	
T2DTCS	-.188**	-.174*	-.011	.007	-.133	-.170*	—

T2DTCS = The Scale for Compliance to the Treatment in Type 2 Diabetes MellitusTotal Score
* p < .05, ** p < .01

Tablo 5. Examination of the relationship between patient compliance with Type 2 diabetes mellitus treatment and metabolic control variable mean scores (n=206)

Variables	1	2	3	4	5	6	7
T2DTCS	—						
FBS (mg/dL)	.219**	—					
PPBS (mg/dL)	.189**	.589**	—				
HbA1c (%)	.143*	.376**	.310**	—			
HDL (mg/dL)	.059	-.049	.073	-.068	—		
LDL (mg/dL)	.003	.089	.041	.245**	-.039	—	
Triglycerides (mg/dL)	.080	.116	.177*	.214*	.068	.172	—

T2DTCS = The Scale for Compliance to the Treatment in Type 2 Diabetes Mellitus Total Score, **FBS** = Fasting Blood Sugar; **PPBS** = Postprandial Blood Sugar; **HbA1c** = Glycated Hemoglobin; **HDL** = High-Density Lipoprotein; **LDL** = Low-Density Lipoprotein; **Triglycerides** = Triglyceride Level.
* p < .05, ** p < .01

Tablo 6. Results of multiple regression analysis regarding the Patient Compliance Scale for Type 2 Diabetes Mellitus Treatment, Diabetes Mellitus Risk Perception Scale subdimensions, and metabolic variable mean scores (n=206)

Dependent Variable	Model	Variables	B	S.Error	β	t	p	95% CI Lower	95% CI Upper
Treatment compliance	1	Fixed	99.058	17.947		5.520	**0.000**	63.194	134.921
		Risk information	-13.414	4.857	-0.303	-2.762	**0.008**	-23.121	-3.708
		Compound risk information	-1.306	1.789	-0.083	-0.730	0.468	-4.881	2.269
		Concern	3.071	2.303	0.147	1.334	0.187	-1.531	7.673
		Optimism	-1.962	2.076	-0.113	-0.945	0.348	-6.110	2.185
		Personal risk of disease	0.339	2.414	0.017	0.141	0.889	-4.484	5.163
		Environmental risk	-13.414	4.857	-0.303	-2.762	0.008	-23.121	-3.708
		FBS (mg/dL)	0.047	0.017	0.399	2.855	**0.006**	0.014	0.081
		PPBS (mg/dL)	0.003	0.016	0.028	0.208	0.836	-0.029	0.036
		HbA1c (%)	0.629	0.384	0.181	1.636	0.107	-0.139	1.397
		HDL (mg/dL)	0.014	0.014	0.104	0.991	0.325	-0.014	0.042
		LDL (mg/dL)	-0.029	0.024	-0.128	-1.212	0.230	-0.076	0.019
		Triglyceride (mg/dL)	0.009	0.010	0.098	0.906	0.368	-0.010	0.028
		R=0.630, R^2=0.397 F=3.765,p<0.001							

FBS= Fasting Blood Glucose; **PPBS=** Postprandial Blood Glucose; **HbA1c=** Glycosylated Hemoglobin; **HDL=** High-density lipoprotein; **LDL=** Low-density lipoprotein; **Triglyceride=** Triglyceride level

0.62, lower than the reported coefficient of 0.77 in the original study (14). This difference may be attributed to variations in the characteristics of the sample, particularly with regard to participants' educational level, duration of illness, and treatment compliance behaviors. Additionally, cultural or contextual differences in interpreting some items may have affected the reliability level. Nevertheless, the obtained Cronbach's alpha value is acceptable for scales used in behavioral and clinical research. It indicates that the scale is still a valid tool for assessing treatment compliance in patients with T2DM.

The Cronbach's alpha coefficient obtained for the total RPS-DM scale in this study (α = 0.79) was close to the lower limit of the range reported for the original Turkish form (α = 0.76–0.92) (16). The lower reliability coefficient (α = 0.65) of the risk knowledge subscale, compared to the other subscales, suggests that participants may have understood the items in this subscale at different levels or that individual differences in knowledge levels increased response diversity. However, the coefficients obtained for the composite risk perception subscale and the other subscales (α = 0.64–0.80) suggest that the scale's internal consistency is generally adequate. These results support using the RPS-DM scale to reliably assess risk perception in patients with T2DM.

This study observed that the level of treatment compliance among patients with T2DM was moderate (79.86 ± 11.46). A study by Erden Melikoğlu et al. on patients with T2DM also observed moderate treatment compliance (17). Another study by Yüce and Yıldırım also found that treatment compliance among T2DM patients was moderate. Other studies have also shown that the level of treatment compliance among patients with T2DM is moderate (18,19). However, in a study by Javanmardifard et al., T2DM patients were found to have low compliance to their treatment regimen. Another study found that 55% of patients had poor treatment compliance (20). These results are largely similar to those of other studies in the literature. It can be concluded that individuals with T2DM do not adhere to treatment at the desired level, which may negatively affect the disease process. Some studies in the literature show different results, which may be attributed to changes in patients' socioculturel factors.

In this study, it was observed that patients with T2DM had the highest mean scores on the risk perception scale for complications in the risk knowledge (2.85 ± 0.28) and optimism (3.02 ± 0.49) subscales. These results suggest that patients exhibited optimistic attitudes despite their high perception of risk regarding complications. Xiong et al.'s study observed that patients with diabetes had a high level of risk perception regarding complications and received the highest scores on the anxiety and optimism subscales (21). In the study by Sağlam and Bektaş, patients with diabetes were found to have a high level of risk perception of complications (3.9 ± 0.8) (11). Kumsar et al. found that patients with diabetes had a good level of risk perception of complications and received the highest scores on the risk knowledge and anxiety sub-dimensions. Risk perception in individuals with diabetes is an important factor affecting disease management and the development of complications (22). The results of this study are mostly similar to those of other studies in the literature. It can be concluded that individuals with type 2 diabetes mellitus have a good knowledge level about the prevention and reduction of disease-related complications.

This study revealed a negative correlation between treatment compliance in patients with T2DM and their risk awareness, composite risk awareness, and environmental risk awareness. It is known that as patients' scores on the treatment compliance scale increase, their treatment compliance weakens. Therefore, it has been observed that patients with high treatment compliance have increased levels of complication risk and environmental risk knowledge. The findings of a study have shown that understanding risk perceptions is necessary to predict self-management behaviors in diabetic patients (23). A systematic review study has shown that treatment compliance in T2DM patients is dependent on the level of knowledge about complications (24). It can be said that patients acquire information about complications while adhering to treatment and adhere to their treatment to delay the progression of complications during this process.

This study observed a positive correlation between treatment adherence and fasting and postprandial blood sugar levels, as well as HbA1c levels, in patients with T2DM. As treatment compliance decreased, these values increased. Thus, it can be concluded that the practices patients engage in during the treatment process are beneficial for maintaining metabolic control. In a study by Pourhabibi et al., it was observed that as patients' HbA1c levels increased, their treatment compliance decreased by 1.84 points (25). However, Yıldırım et al., found no statistically significant relationship between HbA1c values and treatment compliance in patients with T2DM (19). Boas and colleagues found no statistically significant relationship between metabolic control variables and treatment compliance (26). Another study found that as treatment compliance increased, HbA1c levels decreased. Non-compliance to treatment is a risk factor for uncontrolled diabetes in patients with T2DM (20). These findings demonstrate that, as treatment compliance decreases among patients with T2DM, their fasting and

postprandial blood sugar levels and HbA1c levels increase. However, this relationship has been found to be significant in some studies but not in others. These discrepancies may be attributed to variations in study group characteristics, measurement tools, and follow-up periods. This study found that participants had an average HbA1c level of 10.7, which is significantly high. This indicates that they generally had poor glycemic control and difficulty adhering to treatment. According to the literature, HbA1c levels in individuals with T2DM typically fall within the range of 6.4% to 9.9%. These values suggest that glycemic control is suboptimal for a significant proportion of patients (27-30). The mean HbA1c level obtained in this study (10.7%) is above the reported range, which may be related to the majority of the sample being hospitalized individuals with inadequate glycemic control.

This study found that treatment compliance significantly impacted risk awareness and fasting blood sugar levels in patients with T2DM, accounting for 39% of the total effect. These results demonstrate that treatment compliance influences clinical parameters and individuals' perceptions and awareness of the disease. These findings are consistent with previous studies. There is a strong relationship between treatment compliance and risk knowledge in patients with diabetes (31). It is well known that treatment compliance depends on one's belief in potential complications (24). A study by Neto et al. found that treatment compliance significantly impacted HbA1c and cholesterol levels (32). Another study found that low HbA1c levels positively affected treatment compliance (33). Therefore, interventions aimed at increasing treatment compliance should be holistic, addressing medication use as well as patients' knowledge, risk perception, and health awareness.

This study has some limitations. First, the research subjects were only adults with T2DM from one hospital, which may have introduced bias into the research results. Second, the data are based on self-reports, which can lead to social and recall biases. Future studies should take these factors into consideration. Since this study's sample consisted mainly of hospitalized individuals with poor diabetes management, the findings cannot be generalized to the general T2DM population. This is one of the study's significant limitations.

In the present study, a robust statistical relationship was observed between the treatment compliance of patients with t2dm and their risk profile levels, fasting and postprandial blood glucose levels, and HbA1c levels. In addition, the findings of the study demonstrated that treatment compliance levels in individuals with T2DM were significantly influenced by risk awareness, personal risk perception, and fasting blood glucose levels. The analysis revealed that these factors collectively contributed to 39% of the observed variability in treatment compliance levels. The findings indicate that patient compliance with treatment is not solely contingent on metabolic control, but is also influenced by the patient's level of knowledge regarding the illness and their perception of complications. The findings indicate that the implementation of strategies aimed at enhancing treatment compliance must extend beyond a purely medical approach. These strategies are expected to augment patients' knowledge levels. The available evidence suggests that a comprehensive approach is necessary to support motivation and strengthen personal risk awareness. It is hypothesized that structured educational curricula and customized support systems may facilitate the process of coping with diabetes.

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Author Contributions
The study conception and design were contributed by **Gül Dural, Faruk Kılınç;** performed the material preparation, data collection, and analysis. **Gül Dural, Faruk Kılınç** wrote the first draft of the manuscript, and all authors commented on previous versions of the manuscript.

Conflict of Interest
The authors state that they have no conflicts of interest to disclose.

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