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# Evaluation of eating disorders, kinesiophobia and dysfunctional attitudes in patients with type 2 diabetes mellitus

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**Abstract**

**Aim:** Eating disorders (EDs), dysfunctional attitudes (DAs), and limitation of movement due to kinesiophobia, which are more common in patients with type 2 diabetes mellitus (T2DM), may contribute to poor metabolic control, weight gain, disregard for treatment, and an increased prevalence of microvascular and macrovascular complications; however, current evidence is limited to small studies and restricted measures. In this study, these characteristics were assessed in patients with T2DM relative to controls, and factors independently associated with ED, DA and kinesiophobia were examined.

**Material and methods:** This case-control study was conducted between July 2018 and December 2018 at the Departments of Endocrinology and Psychiatry of Erzurum Regional Training and Research Hospital, Erzurum, Turkey. A total of 150 patients diagnosed with T2DM and 150 healthy controls were included. The Eating Attitudes Test (EAT), Dysfunctional Attitude Scale (DAS), and Tampa Scale for Kinesiophobia (TSK) were applied.

**Results:** Median age in the control group was 38 (IQR: 27 - 47) years, and 56 (IQR: 46 - 61) years in the patient group. Women comprised 67.3% of controls and 61.3% of patients. Although all scale scores were higher in the patient group compared to controls, the possible relationships were not confirmed by multiple linear regression analysis. Significant factors independently associated with higher DAS score were high age (p=0.043), high body mass index (p=0.021) and presence of comorbidity (p=0.019). Significant factors associated with higher TSK score were high age (p<0.001) and high BMI (p=0.001). High age (p<0.001) was the only parameter associated with higher EAT score. The presence of T2DM was not found to be an independent factor associated with any of the scores.

**Conclusion:** Our results show that, rather than the presence of T2DM, other patient characteristics were likely to be more influential on ED, DA and kinesiophobia. These show that older patients with T2DM who have comorbidities or DM-related complications are more likely to benefit from management that account for these characteristics.

**Key words:** type 2 diabetes mellitus, dysfunctional attitude scale, tampa scale for kinesiophobia, eating attitudes test

## Introduction

Diabetes Mellitus (DM) is a metabolic disease leading to chronic hyperglycemia caused by impaired insulin secretion or response [1]. Type 2 DM (T2DM) is the most common form of the disease, and is characterized by the combination of poor insulin resistance and poor insulin secretion; whereas and Type 1 DM is caused by a definite absence of insulin secretion [2]. Glycemic control, which is the integral objective of DM management, is associated with both physical and psychological factors in patients

with T2DM [3]. It has been demonstrated that dysfunctional attitudes (DAs), eating disorders (EDs), behavioral disorders and movement disturbance are common in diabetic patients and are associated with poor metabolic control and diabetic complications [3, 4].

While the relationship between T1DM and ED is well known [5], there is little information on the relationship between T2DM and ED [4]. In a review of the literature concerning EDs in T2DM patients, the frequency of ED was shown to range between 0.3–40% [4]. In a large-scale study conducted in Germany, 663 diabetic patients were examined in terms of ED, and the current ED rate in those with T2DM was found to be 8.0% and lifetime ED rate was 14.0% [6]. Regular exercise not only delays the occurrence of T2DM but also has been shown to have possible positive effects on glycemic control. DM complications such as diabetic neuropathy, neuropathic pain and kinesiophobia affect exercise habits in patients with T2DM [7]. Kinesiophobia is defined as the anxiety against activity and physical movement resulting from the feeling of sensitivity to painful injury [8], and T2DM is known to increase the frequency of kinesiophobia [8, 9]. Finally, studies have shown that attitude-related changes and DAs can develop in individuals with chronic diseases [10], and a clear relationship between glycemic control and DA has been reported [3]. There have been studies examining the effects of these three psychophysiological factors in patients with DM; however, these studies are limited by various factors, including the number of participants, absence of controls, lack of comorbidity assessment, as well as limitations in the number or type of scales administered. As such, data on this topic is attained from limited studies without comprehensive assessments, and there is no clarity on whether DM is associated with DA, ED or kinesiophobia.

In this study, we aimed to compare patients with T2DM and controls in terms of ED, DA and kinesiophobia, and to assess whether DM and other patient characteristics were associated with scores for ED, DA and kinesiophobia.

## Material and methods

### Study design

This case control study was conducted between July 2018 and December 2018 at the Endocrinology and Psychiatry Departments of Erzurum Regional Training and Research Hospital, Erzurum, Turkey. The study was initiated after obtaining approval from the Ethics Committee of Erzurum Regional Training and Research Hospital (Ethics committee decision number: 37732058-514.10) and written informed consent was obtained from each of the patients and healthy controls included in the study.

### Study population

A total of 150 patients diagnosed with T2DM according to World Health Organization criteria and 150 healthy controls were included in the study. Patients younger than 15 years of age and older than 70, those with neurological disease affecting cognitive functions, cases with T1DM, those with chronic obstructive pulmonary disease, thyroid dysfunction or other chronic diseases, pregnant or breastfeeding individuals, and those who refused participation were excluded from the study.

### Data collection

All participants were asked to fill out a form collecting various data, including age, sex, marital status, education status, working status, smoking status, comorbidities, DM history in family, application to a dietitian, adherence to a diet, exercise, surgery history, influenza vaccination, pneumococcal vaccine, and psychiatric disease history in the patient and patient's family. Height, weight, waist circumference measurements were made and body mass index (BMI) was calculated. In addition, age at diagnosis, duration of disease, DM-related hospitalization, and drug use information were collected and recorded for the patient group. In patients, history of ketoacidosis or hyperosmolar hyperglycemic state (HHS) history, DM complications, cataract development, glaucoma presence / absence were identified from hospital records. The examined laboratory values of participants were obtained as a result of blood tests requested in routine follow-up or control examinations scheduled during the study period. All laboratory results were studied with blood samples taken from the antecubital vein after 12 hours (night) of fasting and with appropriate devices and techniques in the Biochemistry Laboratory of Erzurum Regional Training and Research Hospital.

### Scales

### The patients and healthy controls were asked to fill out the DAS, TSK, and EAT scales.

Dysfunctional Attitude Scale (DAS): The DAS is used to detect DAs and beliefs in individuals. The validity and reliability study for the Turkish language was performed by Şahin et al. [11]. It consists of 40 items. The items are answered with a seven-point Likert type rating, and the responses are scored as follows: 1: strongly agree, 2: agree, 3: somewhat agree, 4: neutral, 5: somewhat disagree, 6: disagree, and 7: strongly disagree. Items 2, 6, 12, 17, 24, 29, 30, 35, 37, and 40 are scored inversely. While the lowest score that can be obtained from the scale is 40, the highest score is 280 points. High scores indicate that DAs are more frequent. In addition to total score, four subdimension scores can also be calculated, and include "Perfectionism", "Need for approval", "Dependency/Autonomy" and "Inconsistency" [12].

Tampa Scale for Kinesiophobia (TSK): The most commonly used test to assess the presence of kinesiophobia is the TSK. It is a checklist comprising 17 questions [8]. The Turkish validity and reliability study of the scale was conducted by Yilmaz et al. in 2011 [13]. A 4-point Likert-type scoring method is utilized (1: strongly disagree, 4: totally agree). Items 4, 8, 12 and 16 are scored inversely and a total score is calculated. Total score ranges between 17–68 points. A high score on the scale indicates a high level of kinesiophobia [8, 14, 15].

Eating Attitudes Test (EAT-40): One of the tests used to determine eating attitudes and behaviors is the EAT-40. It was developed by Garner and Garfinkel to screen for EA [16]. In Turkey, the validity-reliability study of the test was conducted by Erol and Savaşır [17]. The EAT consists of 40 questions in total. It has a 6-point Likert-type response form (Always, Very Often, Often, Sometimes, Rarely, Never). It is a self-report scale. A cut-off point of ≥30 points is defined for the detection of Disturbed Eating Behaviors [18]. For items 1, 18, 19, 23, 27, and 39, the "sometimes" response is scored as 1 point, "rarely" as 2 points, and "never" as 3 points, while other options are evaluated as 0 points. For the other items of the scale, the "always" response is evaluated as 3 points, "very often" is evaluated as 2 points, and "often" is evaluated as 1 point, while other responses receive 0 points. Individuals scoring between 30 and 32 on EAT represent a segment of the general population who do not have any diagnosed ED symptoms but differ from the general population

in terms of eating attitudes. Those who score 33 and above have been found to demonstrate pathological eating symptoms [1, 17, 18].

## Statistical Analysis

All analyses, subject to a p value threshold of 0.05 for significance, were performed on SPSS ver. 25.0. Histogram and Q-Q plots were evaluated to assess normality of distribution. Data are given as mean ± standard deviation or median (1st quartile - 3rd quartile; referred to as IQR) for continuous variables according to normality of distribution, and as frequency (percentage) for categorical variables. Continuous variables were compared between groups with appropriate tests according to normality findings (normally distributed: independent samples t-test, non-normally distributed: Mann-Whitney U test). Categorical variables were analyzed with chi-square tests, or the Fisher's exact test where necessary. Multiple linear regression analysis (stepwise selection method) was performed to determine factors independently associated with dysfunctional attitudes, kinesiophobia and eating attitudes. All parameters demonstrating univariate differences between the control.

## Results

The median age of all participants was 47 (IQR: 36-57) years; however, median age was 38 (IQR: 27 - 47) in controls and 56 (IQR: 46 - 61) years in patients. The age distribution demonstrated significant difference (p<0.001). In terms of sex, 64.3% of all participants, 67.3% in the control group and 61.3% in the patient group, were women (p=0.278). Other individual characteristics and laboratory values of all participants are depicted and compared based on the groups in Table 1 and Table 2. The summary of DM-related characteristics are shown in Table 3.

Table 1 Summary of individuals' characteristics with regard to groups

| | Groups | | | |
|---|---|---|---|---|
| | Total | Control (n=150) | Type II DM (n=150) | p |
| Age | 47 (36 - 57) | 38 (27 - 47) | 56 (46 - 61) | **<0.001** |
| Sex | | | | |
| Female | 193 (64.3%) | 101 (67.3%) | 92 (61.3%) | 0.278 |
| Male | 107 (35.7%) | 49 (32.7%) | 58 (38.7%) | |
| Height | 163.89 ± 9.14 | 165.19 ± 8.60 | 162.60 ± 9.51 | **0.014** |
| Weight | 77.10 ± 14.59 | 73.98 ± 14.88 | 80.22 ± 13.64 | **<0.001** |
| Body mass index | 28.86 ± 5.93 | 27.11 ± 5.06 | 30.60 ± 6.24 | **<0.001** |
| Waist circumference | 98.18 ± 12.85 | 93.54 ± 12.27 | 102.81 ± 11.73 | **<0.001** |
| Marital status | | | | |
| Married | 250 (83.3%) | 115 (76.7%) | 135 (90.0%) | **<0.001** |
| Single | 38 (12.7%) | 35 (23.3%) | 3 (2.0%) | |
| Divorced/Widowed | 12 (4.0%) | 0 (0.0%) | 12 (8.0%) | |
| Education status | | | | |
| Literate | 77 (25.7%) | 16 (10.7%) | 61 (40.7%) | **<0.001** |
| Primary school | 95 (31.7%) | 45 (30.0%) | 50 (33.3%) | |
| High school | 53 (17.7%) | 35 (23.3%) | 18 (12.0%) | |
| University | 75 (25.0%) | 54 (36.0%) | 21 (14.0%) | |
| Working status | | | | |
| Working | 209 (69.7%) | 96 (64.0%) | 113 (75.3%) | **0.033** |
| Not working | 91 (30.3%) | 54 (36.0%) | 37 (24.7%) | |
| Smoker | 43 (14.3%) | 22 (14.7%) | 21 (14.0%) | 1.000 |
| Comorbidities | 93 (31.0%) | 0 (0.0%) | 93 (62.0%) | **<0.001** |
| Hypertension | 56 (18.7%) | 0 (0.0%) | 56 (37.3%) | **<0.001** |
| Dyslipidemia | 56 (18.7%) | 0 (0.0%) | 56 (37.3%) | **<0.001** |
| DM history in family | | | | |
| First degree | 119 (39.7%) | 48 (32.0%) | 71 (47.3%) | **0.007** |
| Second degree | 154 (51.3%) | 53 (35.3%) | 101 (67.3%) | **<0.001** |
| Apply to a dietitian | 116 (38.7%) | 11 (7.3%) | 105 (70.0%) | **<0.001** |
| Following a diet | 61 (20.3%) | 12 (8.0%) | 49 (32.7%) | **<0.001** |
| Regular exercise | 56 (18.7%) | 30 (20.0%) | 26 (17.3%) | 0.553 |
| Surgery history | 115 (38.3%) | 39 (26.0%) | 76 (50.7%) | **<0.001** |
| Influenza vaccination | 11 (3.7%) | 4 (2.7%) | 7 (4.7%) | 0.539 |
| Pneumococcal vaccine | 2 (0.7%) | 1 (0.7%) | 1 (0.7%) | 1.000 |
| Psychiatric disease | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | N/A |
| Psychiatric disease in family | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | N/A |

Data are given as mean ± standard deviation or median (1st quartile - 3rd quartile) for continuous variables according to normality of distribution and as frequency (percentage) for categorical variables

Table 2 Summary of laboratory measurements with regard to groups

| | Groups | | | |
|---|---|---|---|---|
| | Total | Control (n=150) | Type II DM (n=150) | p |
| Fasting blood glucose | 104.5 (93 - 146.5) | 95 (87 - 102) | 146.5 (113 - 224) | **<0.001** |
| Postprandial blood glucose | 130 (99 - 208) | 100.5 (90 - 121) | 208 (151 - 292) | **<0.001** |
| HbA1c | 6.1 (5.6 - 7.9) | 5.6 (5.4 - 5.9) | 7.9 (6.8 - 9.7) | **<0.001** |
| BUN | 14 (11 - 17) | 12.5 (10.5 - 15.5) | 14.6 (11.9 - 18.5) | **<0.001** |
| Creatinine | 0.77 (0.70 - 0.90) | 0.75 (0.69 - 0.83) | 0.81 (0.72 - 0.96) | **<0.001** |
| GFR | 99 (89 - 110) | 106 (97 - 117) | 92 (76 - 102) | **<0.001** |
| ALT | 18 (14 - 27) | 18 (13 - 26) | 20 (15 - 27) | **0.041** |
| AST | 17 (14 - 21) | 18 (14 - 21) | 17 (14 - 21) | 0.202 |
| Albumin | 4.36 ± 0.31 | 4.44 ± 0.27 | 4.29 ± 0.32 | **<0.001** |
| Total cholesterol | 196.27 ± 42.96 | 190.45 ± 35.79 | 202.09 ± 48.52 | **0.019** |
| HDL | 47.84 ± 11.92 | 50.17 ± 11.28 | 45.52 ± 12.12 | **0.001** |
| Triglyceride | 128.5 (79.5 - 184) | 104 (68 - 159) | 150 (110 - 215) | **<0.001** |
| LDL | 121.75 ± 34.74 | 117.35 ± 29.92 | 126.14 ± 38.57 | **0.028** |
| Sodium | 138.50 ± 2.25 | 138.77 ± 1.74 | 138.23 ± 2.65 | **0.040** |
| Potassium | 4.37 ± 0.33 | 4.31 ± 0.30 | 4.43 ± 0.35 | **0.002** |
| Calcium | 9.66 ± 0.53 | 9.62 ± 0.46 | 9.70 ± 0.59 | 0.156 |
| Uric acid | 4.72 (3.78 - 5.77) | 4.69 (3.54 - 5.59) | 4.78 (4.00 - 6.03) | 0.086 |
| CRP | 0.30 (0.30 - 0.52) | 0.30 (0.30 - 0.39) | 0.38 (0.30 - 0.74) | **<0.001** |
| Ketonuria | 2 (0.7%) | 0 (0.0%) | 2 (1.3%) | 0.498 |
| Proteinuria | 15 (5.0%) | 0 (0.0%) | 15 (10.0%) | **<0.001** |
| Glycosuria | 50 (16.7%) | 0 (0.0%) | 50 (33.3%) | **<0.001** |
| Spot urine total protein/ creatinine | 106.5 (87 - 164.5) | 98 (76 - 128) | 135 (100 - 248) | **<0.001** |
| Hemoglobin | 14.21 ± 1.71 | 14.19 ± 1.76 | 14.23 ± 1.65 | 0.853 |
| Hematocrit | 44.13 ± 4.55 | 43.99 ± 4.59 | 44.28 ± 4.52 | 0.589 |
| MCV | 84.46 ± 5.38 | 84.42 ± 5.60 | 84.50 ± 5.17 | 0.902 |
| Platelet (x103) | 282.17 ± 72.21 | 278.89 ± 67.56 | 285.45 ± 76.67 | 0.432 |
| RDW | 13.1 (12.6 - 14.1) | 12.95 (12.5 - 13.5) | 13.3 (12.7 - 14.4) | **0.001** |
| PDW | 12.54 ± 1.92 | 12.63 ± 2.03 | 12.44 ± 1.81 | 0.394 |
| MPV | 10.48 ± 0.87 | 10.56 ± 0.92 | 10.40 ± 0.80 | 0.114 |
| PCT | 0.29 ± 0.07 | 0.29 ± 0.06 | 0.30 ± 0.08 | 0.476 |
| WBC (x103) | 7.35 ± 1.93 | 6.95 ± 1.52 | 7.74 ± 2.21 | **<0.001** |
| Neutrophil (x103) | 3.94 (3.16 - 4.98) | 3.83 (3.09 - 4.59) | 4.16 (3.29 - 5.22) | **0.011** |
| Sedimentation | 11 (6 - 17) | 8 (4 - 13) | 13 (8 - 20) | **<0.001** |
| TSH | 1.56 (1.02 - 2.40) | 1.77 (1.25 - 2.78) | 1.40 (0.87 - 2.10) | **0.001** |
| Free T4 | 0.99 ± 0.14 | 0.98 ± 0.14 | 1.01 ± 0.14 | 0.080 |

Data are given as mean ± standard deviation or median (1st quartile - 3rd quartile) for continuous variables according to normality of distribution and as frequency (percentage) for categorical variables

The differences between the groups in terms of the scores of the scales were as follows: both the total DAS score (p<0.001) and all four subdimension scores were found to be significantly higher in patients compared to controls (perfectionism: p=0.001, need for approval: p<0.001, dependency/autonomy: p=0.023, inconsistency: p=0.005). Likewise, the TSK (p<0.001) and EAT (p<0.001) scores in the patient group were also significantly higher relative to the control group (Table 4).

We performed multiple linear regression analysis to determine significant factors that could predict DA, ED and kinesiophobia. We found high age (p=0.043), high BMI (p=0.021) and presence of comorbidity (p=0.019) were independently associated with higher DAS total score. Other variables included in the model, T2DM (p=0.368), sex (p=0.184), marital status (p=0.652), education status (p=0.419) and working status (p=0.301) were found to be non-significant for DAS (Table 5). We found that high age (p<0.001) and high BMI (p=0.001) were independently associated with higher TSK score. Other variables included in the model, T2DM (p=0.953), sex (p=0.314), marital status (p=0.199), education status (p=0.330), working status (p=0.119) and presence of comorbidity (p=0.434) were non-significant for TSK (Table 6). Finally, high age (p<0.001) was determined to be the only parameter associated with higher EAT score. Other variables included in the model, T2DM (p=0.274), sex (p=0.203), marital status (p=0.938), education status (p=0.205) and working status (p=0.149) were found to be non-significant for EAT (Table 7).

Table 3 Summary of diabetes mellitus-related characteristics

| | |
|---|---|
| Age at diagnosis | 47.67 ± 9.86 |
| Duration of disease | 4 (1 - 10) |
| Drug use | |
| No | 0 (0.0%) |
| Oral antidiabetic | 87 (58.0%) |
| Insulin | 27 (18.0%) |
| Oral antidiabetic + Insulin | 36 (24.0%) |
| DM-related hospitalization | |
| No | 115 (76.7%) |
| 1 | 30 (20.0%) |
| 2 | 3 (2.0%) |
| 3 | 1 (0.7%) |
| 4 | 1 (0.7%) |
| Ketoacidosis/HHS coma history | 5 (3.3%) |
| DM-related complication(s) | 82 (54.7%) |
| Retinopathy | 36 (24.0%) |
| Neuropathy | 67 (44.7%) |
| Nephropathy | 45 (30.0%) |
| Coronary artery disease | 26 (17.3%) |
| Coronary angiography | 26 (17.3%) |
| Coronary artery bypass graft | 1 (0.7%) |
| Diabetic foot ulcer | 7 (4.7%) |
| Amputation | 0 (0.0%) |
| Cataract | 29 (19.3%) |
| Glaucoma | 5 (3.3%) |

Data are given as mean ± standard deviation or median (1st quartile - 3rd quartile) for continuous variables according to normality of distribution and as frequency (percentage) for categorical variables.

## Discussion

The relationship between the development of T2DM and environmental factors, metabolic parameters, nutritional habits and physical activity has been demonstrated by many studies [19-22]. ED, DA, and limitation of movement due to kinesiophobia, which are more common in patients with T2DM, may contribute to poor metabolic control, weight gain, disregard for treatment, and an increased prevalence of microvascular complications. The coexistence of DM and ED, DA and kinesiophobia poses a high risk in terms of morbidity and mortality [8, 12, 23]. In this study we aimed to compare the rates of ED, DA and kinesiophobia in patients with T2DM to those without DM. Despite a significant difference in age between the groups, we found that total and subdimension scores of DAS, TSK score and EAT score were significantly higher in patients with T2DM compared to controls; however, interestingly, multiple linear regression revealed that the presence of T2DM was not associated with the scores obtained from any of the tests. High age, high BMI, and presence of comorbidity were related with higher DAS total score, high age and high BMI were related with higher TSK score, and high age was the only parameter independently associated with higher EAT score.

Many studies focusing on the effects of psychological problems on diabetes reveal that psychological factors are effective on diabetes control [10, 24]. It has been seen that DA can develop in individuals with chronic diseases. A patient who has not been successful in treatment for any reason may attempt to resort to different methods, leading to non-beneficial beliefs regarding their disease and treatment. In such cases, the patient is reluctant to adhere to their main treatment [10]. A person's DAs combined with negative life events can produce automatic and involuntary negative thoughts [3, 25]. Therefore, this situation is especially important for DM patients in which long-term compliance with treatment is required. Patients should be examined in this regard and psychological support should be provided to prevent adverse events [10].

Table 4 Summary of scale scores with regard to groups

| | | Groups | | |
|---|---|---|---|---|
| | Total | Control (n=150) | Type II DM (n=150) | p |
| Dysfunctional Attitude Scale | | | | |
| Total | 137.75 ± 34.40 | 128.89 ± 32.77 | 146.61 ± 33.81 | **<0.001** |
| Perfectionism | 51 (39 - 64.5) | 47.5 (36 - 61) | 56 (43 - 73) | **0.001** |
| Need for approval | 37 (28 - 49) | 31.5 (24 - 41) | 43 (33 - 54) | **<0.001** |
| Dependency/Autonomy | 24.12 ± 7.61 | 25.12 ± 8.12 | 23.13 ± 6.94 | **0.023** |
| Inconsistency | 20.16 ± 5.36 | 19.29 ± 5.70 | 21.03 ± 4.85 | **0.005** |
| Tampa Scale for Kinesiophobia | 36.77 ± 11.83 | 34.07 ± 11.27 | 39.47 ± 11.79 | **<0.001** |
| Eating Attitudes Test | 23 (18 - 32) | 21 (16 - 28) | 27 (19 - 35) | **<0.001** |

Data are given as mean ± standard deviation or median (1st quartile - 3rd quartile) for continuous variables according to normality of distribution.

In a study conducted in Beijing which evaluated DAS in 245 patients with T2DM, it was found that DA had a close relationship with HbA1C, and those with high HbA1C values had higher scores on the DAS. The authors stated that there was a significant relationship between the glycemic control of patients and findings associated with DAs [3]. In another study in which 17 T1DM and T2DM patients and 34 non-diabetic controls were included, no difference was found in terms of DAS scores between the two groups, although the incidence of depression was higher in the patient group [26]. In our study, the DAS total and subdimension scores were determined to be significantly higher in the T2DM group compared to controls. However, this possible relationship was not present in multiple linear regression analysis. High BMI, high age and the presence of comorbidity were related with higher DAS total score, suggesting that the metabolic background or underlying factors of patients were the factors that contributed to DAs. Successful management of DM largely depends on the ability of patients

to manage their disease. Studies show that individuals with DM experience various psychosocial and emotional problems that can influence DM management [24]. Considering our results showing the pronounced effect of comorbidity, age and BMI on DA, it appears that it would be beneficial to closely monitor older patients with T2DM who have comorbid diseases including metabolic syndrome.

It has been found that the increase in the frequency of T2DM in recent times is mostly associated with weight gain and decreased physical activity [19, 20]. In diabetic individuals, regular exercise has been shown to improve glucose tolerance, increase insulin sensitivity, lower HbA1C levels, and help control weight and cardiovascular risk factors [8]. The fear of movement, called kinesiophobia, is especially seen in patients with chronic pain. Patients avoid movement for the fear of suffering from pain [27]. This situation can cause more serious problems in diabetes patients, where physical activity and healthy social life are important. As the patient avoids exercise, blood sugar regulation will be more difficult, the chance of maintaining an ideal weight will decrease, and psychological discomfort will also contribute to hyperglycemia. In this respect, kinesiophobia is of great importance in the treatment and prevention of complications in patients with DM [7, 27]. In a case-control study, it was observed that individuals with T2DM had higher levels of kinesiophobia than nondiabetic participants, as determined by TSK results [8]. In the analyses of another study that included 154 patients with neuropathic pain, it was shown that diabetic neuropathy pain and fear of movement had a close relationship. It has been stated that the intensity and duration of pain and the presence of fear of falling reduce quality of life in patients with diabetic neuropathy. It was also found that pain intensity, male sex, and fear of falling were positively correlated with inactivity. As a result, it was emphasized that patients with diabetic neuropathy may have fears concerning movement, falls and pain, and that the quality of life of patients may decrease due to these fears; interestingly, the study reported no significant relationship between age and kinesiophobia [9]. In our study, we found TSK scores to be significantly higher in the T2DM group, which supports previous studies in this regard; however, regression revealed that the presence of T2DM was not a factor that increased TSK scores. It was seen that TSK scores showed a positive correlation with age and BMI. Therefore, the management approach to older T2DM patients with obesity should include evaluation of kinesiophobia, especially when painful comorbidities are present.

The development, treatment and complications of DM are closely related to diet and eating habits. The necessity of diet, the presence of a chronic process, some prohibitions and restrictions may cause anxiety in patients. For all these reasons, deterioration in eating attitudes and behaviors of patients can be observed [28]. Eds may also reduce the quality of life of patients by leading to deterioration in social functionality and physical activities [29]. There is a bidirectional relationship between ED and T2DM: such patients may have an increased risk of developing ED due to difficulties in adherence to strict diets and the presence of obesity at baseline. Secondly, since Eds evidently influence weight gain, the course and treatment of T2DM and its management may be complicated [4]. The coexistence of ED and T2DM appears to be widely variable in different studies.

In a study, the frequency of abnormal eating was found to be 40% among patients, and the logistic regression analysis of the study showed that there was a significant relationship between abnormal eating behavior and being aged <60 years [30]. In the study by Celik et al., 29.6% of patients were found to have an EAT score above 30 (i.e., had disordered eating attitudes), but there were no significant correlations between EAT scores, BMI and age [10]. In a cross-sectional study, the score obtained with the EAT-26 was found to be higher among individuals with T2DM compared to controls. In the same study, no significant difference was observed between patients with and without ED (according to EAT score) in terms of sex, age, education level, employment status, marital situation, T2DM duration, BMI, and presence of comorbidities [23]. In another cross-sectional study examining the effect of eating attitudes on the quality of life of individuals with T2DM, it was observed that 42.7% of the participants had an EAT score meeting the ≥30-point cut-off. These individuals were also found to demonstrate a higher score concerning worries about social and vocational issues as compared to those with lower scores (<30 points). In the same study, while no significant correlation was found between EAT scores and age, a significant positive correlation was found between EAT total score and BMI [1]. In a study from Turkey including 150 patients with T2DM, 26% of patients were found to have an EAT score of 30 or above. Furthermore, the authors found no significant relationship between EAT scores and sex, age, marital status, education, employment, economic standing, diabetes complications and BMI [18]. In the present study, all patients in the control group had an EAT score below 30. Although the EAT scores of T2DM patients were found to be significantly higher than the control group, regression analysis revealed that the presence of T2DM alone was not an independent factor associated with ED. High age was determined to be the only factor related with high EAT score. Although evidence from previous studies suggest that ED is associated with adverse outcomes [29] and the acute and chronic complications of diabetes [29], our regression results do not support these suggestions. Nonetheless, the significant differences between the T2DM and control groups should be mentioned, with emphasis on the fact that other underlying factors including age must be considered.

Our study has some limitations. First, the fact that it was a single-center study limited the generalizability of the results. Second, the differences in age, sociodemographic characteristics and laboratory results between the patient and control groups may have affected the results. In order to obtain clearer results, multicenter studies with larger patient counts and homogenous distribution of characteristics among groups are required.

In conclusion, although the data we obtained showed that DA, ED and kinesiophobia were more common in T2DM patients than in controls, these univariate relationships were not confirmed by regression analysis. In addition, it was observed that the probability of the occurrence of all three disorders increased with age. Furthermore, high BMI increased the frequency of DA and kinesiophobia, and DA was more common in those with comorbidities. For successful T2DM management, in addition to appropriate medical treatment, supportive approaches for nutrition, physical activity and mental support are required in particularly older patients with comorbidities and higher BMI.

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