Psychometric Evaluation of the Diabetes Distress Scale in Patients with Type 2 Diabetes in Turkey

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Abstract

The objective of the research was to evaluate the validity and reliability of the Diabetes Distress Scale in patients with type 2 diabetes in Turkey.

Materials and Methods. Our study was conducted between September 2016 and January 2017 and included 170 patients with type 2 diabetes. The Personal Information Form and Diabetes Distress Scale were used as a data collection tool. Statistical analysis was performed using SPSS 23.0 and SAS package program.

Results. According to the results of the research, Cronbach's alpha reliability for the total scale was 0.91. The model fit indices for the revised confirmatory factor analysis model failed to meet the criteria for acceptability: the GFI was 0.8185, the CFI was 0.9316, the Bentler - Bonett (1980) NFI was 0.9005, and the RMSEA was 0.1067. In our study, exploratory factor analysis provided support for the three-factor model: [I] emotional and regimen-related distress, [II] health professional-related distress, [III] diabetes-related interpersonal distress.

Conclusions. When the translation and cultural adaptation process have been considered, the Diabetes Distress Scale is a valid and reliable tool for the Turkish community. It is recommended to be used in the studies and clinical trials.

Keywords

Type 2 Diabetes; Reliability; Validity; Diabetes Distress Scale

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Introduction

Diabetes mellitus (DM) is a disease that develops as a result of insulin resistance, decreased production and use of insulin, and is associated with poor lifestyle choices and obesity [1]. According to the International Diabetes Federation (IDF), in 2019, the prevalence of diabetes among the global adult population reached 9.3%; there were approximately 463 million individuals with diabetes; approximately 4.2 million individuals died from diabetes and its complications [2]. According to the results of the Turkish DM Epidemiology Study (TURDEP-II), the prevalence of DM was found to be 13.7% [3].

A lot of people still fail to meet the recommended treatment goals, despite improved technologies, new oral medications, and better insulin. Therefore, patients may feel exhausted, overwhelmed, or fed up. Such problems have been reported to negatively affect blood glucose control and quality of life [4–6]. Organizations such as the American Diabetes Association and the International Diabetes Federation recommend developing tools to detect such psy-

chological problems [7, 8].

Emotional burdens and concerns related to the management of diabetes, risk of complications, unmet needs from healthcare providers, friends, and family are defined as diabetes distress [5, 9]. Diabetes distress is associated with higher glycosylated hemoglobin (HbA1c) test [10] and lower diabetes-related quality of life [11]. In addition, untreated psychological disorders such as stress and distress can lead to cardiovascular problems, depression, and cognitive decline [12, 13]. In addition, a study has found that participants with uncontrolled HbA1c had significantly higher mean Diabetes Distress Scale (DDS) scores with a significant positive correlation between the last measured HbA1c level and the number of ketoacidosis attacks and DDS scores [14]. These findings highlighted the importance of routine screening for diabetes distress and clinically significant depressive symptoms [11].

Therefore, valid and reliable instruments for assessing diabetes distress are needed to discriminate between the levels of diabetes-related emotional problems and those who are clinically depressed. Many scales with differ-

ent contents have been developed for the holistic evaluation of individuals with diabetes [15]. Having scales that identify individual needs provides support for designing effective educational interventions, as well as promoting collaborative interventions in the fight against disease [16]. The DDS has been used in different cultures and clinical practices [8, 17–19]. In the literature, validity and reliability studies of the scale have been conducted in many countries such as China [17], Norway [18], and Denmark [20]. No scale in Turkey can assess the level of distress related to diabetes.

Therefore, **the objective of our research** was to make the validity and reliability of the DDS-17 scale for Turkish society.

Materials and Methods

Initially, the validity and reliability studies were carried out within the scope of the Turkish adaptation of the original scale, by examining the psycholinguistic structure (language adaptation) and the psychometric structure (validity-reliability), comparing cross-cultural characteristics. Within the scope of validity, language validity, content validity, and construct validity were made. In the language validity phase, the translation (English-Turkish) and back-translation (Turkish-English) methods were used. Within the scope of construct validity, confirmatory and exploratory factor analyzes of the data were made. Internal consistency and item analysis were evaluated within the scope of reliability. Internal consistency analysis was determined by the Cronbach's alpha coefficient; item analysis was determined by Pearson product-moment correlation.

Design and Sample

We invited patients with type 2 diabetes to participate in this cross-sectional survey study by visiting an endocrinology outpatient clinic at University Hospital in Turkey between September 15, 2016, and January 15, 2017. Inclusion criteria were as follows: 1) 18 years of age or older; 2) diagnosis of diabetes with disease onset ≥ 1 year; 3) absence of any psychiatric disorder; 4) accepting to participate in the study.

Participants were verbally informed of the purpose and protocols of the study, the time required for their participation, and that they could refuse if they wished. The sample size was calculated based on the participant ratio of 1:5 or 1:10 [20] items in the DDS-17. The DDS-17 has 17 elements. The minimum number of participants required to better realize the dimensionality of the instrument is $17 \times 10 = 170$.

Data Instruments

Demographics

A basic demographic questionnaire was used to collect descriptive data of the participants (such as age, gender, occupation status, education, employment status, illness duration, treatment methods, other chronic diseases, body mass index.)

Diabetes Distress Scale-17

The original 17-item DDS was tested by Polonsky *et al.* on patients with type 1 and 2 in both primary care and specialist settings [21]. The DDS-17 was developed in 2005 to overcome limitations of previous measures of diabetes distress. The total items were divided into four subscales, covering the life of diabetic patients: emotional burden (5 items); physician-related distress (4 items); regimen-related distress (5 items); diabetes-related interpersonal distress (3 items). The response to each item was based on a 6-point Likert scale, rated from 1 (not a problem) to 6 (a very serious problem) concerning diabetes over the past 1 month; thus, higher values indicated greater distress [21]. A mean item score of ≥ 3 (high distress) was considered as a level of distress worthy of clinical attention, whereas an overall mean score of < 2.0 indicated “little to no distress”, a score between 2.0 and 2.9 indicated “moderate distress” [21–24]. The original version of the DDS-17 is reliable (Cronbach's $\alpha = 0.93$) [21].

Translation Procedure

First, the Turkish translation of the original scale was made (Fig. 1). It was performed independently by two

Figure 1. Flowchart depicting the process used for translation, validation and item evaluation of the instrument.

translators who are fluent in both English and Turkish; one of them was a medical officer in practice as a general practitioner and the other one was a qualified linguistic translator. Later, the Turkish version was translated back into the original language. This process was carried out by another two translators, a general practitioner, and a qualified linguistic translator. In the last step of the translation procedure, the Turkish version was reviewed by an expert panel: professional translator, medical specialist in diabetes, nutritionist, two nurses with diabetes experience in the adaptation and validation of tools. In addition, two researchers took part. A final version ready to be tested was created.

After modification to the terminology, the Turkish version was applied to 10 Turkish patients who met the study criteria. Independent classifications of the DDS-17-Turkish (DDS-17-T) items yielded a good inter-rater agreement (Kendall's $W = 0.65$), and the consensus discussion yielded a full agreement. Participants were explained the purpose of the study. In addition, they were informed if they had difficulties in understanding the items of the scale. Participants did not report any problems. The findings of these individuals were not included in the validity and reliability studies (Fig. 1).

Statistical Analysis

Statistical analysis was carried out by using the IBM SPSS statistical program (v. 23.0; IBM Corporation, Armonk, NY, USA) with a significance level of $p < 0.05$. Three methods were used to test the psychometric properties of the DDS-17-T, namely factor analysis, item analysis, and internal consistency. Confirmatory factor analysis (CFA) was first conducted on this study sample to confirm the exploratory model developed by Polonsky *et al.* (2005) [21]. If the model fit is unsatisfactory, then, efforts to respecify the model, using modification indices, are completed and the revised model is re-evaluated with CFA. If the revised model continues to demonstrate poor fit, then, exploratory factor analysis (EFA) is used to examine the factor structure to determine if there is an empirical basis to revise the subscales of the test. In these model fit criteria, a model is suitable if the goodness of fit index (GFI) value is greater than 0.9, the adjusted goodness of fit index (AGFI) value is greater than 0.8, the root mean square error of approximation (RMSEA) value is less than 0.08, and the comparative fit index (CFI) and non-normed fit index (NNFI) values are greater than 0.95 [25, 26]. Before EFA, the Kaiser-Meyer-Olkin (KMO) value was analyzed to determine whether the sample was adequate or not, and the Bartlett test was used to determine whether the correlation matrix was a unit matrix, indicating a rationale for factor analysis. In the literature, factor loading of ≥ 0.40 is recommended for each item [27]. We used Cronbach's alpha to determine internal consistency for the DDS-17-T total scores and DDS-17-T subscales.

Results

Sample Characteristics

In this study, 170 patients with type 2 diabetes were interviewed. The average HbA1c value was 7.0 (SD = 1.38). The mean age was 58.9 years; the duration of diabetes was 2.1 years; 62.4% of the patients were females. Most of the participants (80%) were receiving oral medication (either monotherapy or combinations of two or three oral antidiabetic drugs), and a total of 41.2% had obesity. Sociodemographic characteristics and clinical conditions of the participants are shown in Table 1.

Table 1. Demographic and medical characteristics of the patients with type 2 diabetes (n = 170).

	Mean $\pm$ SD	Range
HbA1c (%)	7.0 $\pm$ 1.38	5.3 - 12.9
Age (years)	58.9 $\pm$ 1.02	20 - 65
Illness duration (years)	2.1 $\pm$ 0.78	1 - 25
	n	%
Gender		
Female	106	62.4
Male	64	37.6
Marital status		
Married	158	92.9
Single	12	12.1
Occupational status		
Housewife	73	42.9
Retired	69	40.6
Public servant	19	11.2
Self-employed	9	5.3
Education		
Illiterate	21	7.2
Primary	81	47.6
Secondary	14	8.2
High	30	17.6
University	33	19.4
Employment status		
Unemployed	143	84.1
Employed	27	15.9
Duration of the illness		
< 5 year	47	27.6
6 - 10 year	66	38.8
> 10 year	57	33.6
Treatment methods		
Medical nutrition therapy	340	100
Oral antidiabetic agents	136	80
Exercises	100	58.8
Insulin injections	50	29.4
Antidiabetic agents+insulin	16	9.4
Other chronic diseases		
Hypertension	79	46.5
Thyroid diseases	35	20.6
Cardiovascular disease	34	20
Body mass index		
18.5 - 24.9 (normal weight)	25	14.7
25 - 29.9 (overweight)	63	37.1
30 - 39.9 (obesity)	70	41.2
40 > (morbid obesity)	12	7.0

Factorial Validity

The validation study of this scale was carried out using CFA and EFA. First, CFA was performed in the SAS program for construct validity of the DDS-17-T. All model fit indices for the revised CFA model narrowly failed to meet the criteria for acceptability: the GFI was 0.8185 ($\chi^2 (109) = 318.7381$, $p < 0.0001$), the CFI was 0.9316, the Bentler - Bonett (1980) NFI was 0.9005, and the RMSEA was 0.1067 (90% lower confidence limit) (Table 2). The Bentler's CFI was just below acceptable one, indicating moderate fit. These results indicated that the fit between the model and the data required improvement, as well as the need for EFA modification of the model.

Table 2. Goodness of fit indices for the Diabetes Distress Scale - Turkish version

Index	Values
GFI	0.8185
AGFI	0.7453
Chi-Square	318.7381
Chi-Square DF	109
Pr > Chi-Square	< 0.0001
RMSEA Estimate	0.1067
Bentler's CFI	0.9316
Bentler - Bonett (1980) NFI	0.9005

In the second stage, EFA was conducted. The results of EFA showed a KMO value of 0.88, indicating sample adequacy for factor analysis. The Bartlett's test of sphericity was significant ($\chi^2 = 3078$, $p < 0.001$). This result showed that the data were suitable for further analysis. Factor 1 (emotional and regimen-related distress) (40.19%) included ten items (2, 3, 4, 6, 7, 8, 10, 12, 14, 16); Factor 2 (health professional-related distress) (20.21%) included four items (1, 5, 11, 15); Factor 3 (interpersonal distress) (16.84%) included three items (9, 13, 17). The emotional distress and regime distress subscales were combined as one factor. The other subscales were completely similar to the original subscales. All components explained 77.25% of the total variance (Table 3, Fig. 2).

The component correlation matrix presents the correlation between the extracted factors/components and is, therefore, important for choosing between vertical and oblique rotation. In our study, the factor correlation matrix of the subscales is given in Table 4.

Internal Consistency Reliability

Internal consistency is evaluated using the Cronbach's alpha coefficient to determine whether all items in a multi-item scale measure the same concept. The Cronbach's alpha value > 0.70 has sufficient internal consistency [28]. In our study, the Cronbach's alpha value was calculated for the whole instrument and each subscale. Following the three patterns from the EFA in this study, Cronbach's alpha was 0.94 for the combined emotional and regimen-related distress subscale, 0.92 for the health professional-related distress subscale, and 0.96 for the diabetes-related interpersonal distress subscale. These alpha values were

Figure 2. Confirmatory Factor Analysis.

sufficient, especially considering the number of items per scale (Table 5).

Discussion

The validity and reliable scales are needed to reveal diabetes-related emotional distress. The DDS was developed in English to identify diabetes-related emotional distress and areas of concern [21, 29]. It is seen in the literature that adaptations to many languages have been made [17, 18, 20, 30]. The main objective of this paper was to report the reliability and validity of the DDS-17-T in a sample of adult Turkish patients with type 2 diabetes.

In the Turkish translation of the original scale, the expression “health professionals” was used instead of doctors only in items 1, 5, 11, and 15. Otherwise, no changes were made. Nurses play an important role in promoting patients' self-care. Not only language translation is needed to apply an existing scale for an intercultural study, cultural and environmental contexts of equal importance need to be considered as well [31]. This was similar to the Thai DDS-17 validation study in Thailand, where the “physician distress” domain was also modified and renamed “physician- and nurse-related distress” [32].

In our study, EFA supported the three-factor model rather than the four-factor model in the original DDS-17. The factor structure of the DDS-17-T differs from that of the original DDS-17 in that emotional burden and regime-related distress are included in the same factor. This factor structure is different from the original scale that has four factors but is similar to the DDS-17 validated in China (CDDS) [17] and Thailand (Thai DDS-17) [32]. This difference can be attributed to the cultural differences of Turkish patients who think that lifelong treatment and self-

Table 3. Factor loading, pattern matrix and structure matrix of the Diabetes Distress Scale - Turkish version (n = 170).

ITEMS					Pattern Matrix	Structure Matrix
Factor 1 (Emotional and regimen-related distress)		F1	F2	F3		
(2)	Feeling that diabetes is taking up too much mental and physical energy every day.	0.798	-0.278	-0.097	1.085	0.806
(3)	Feeling not enough confident in my day-to-day ability to manage diabetes.	0.883	-0.299	-0.112	1.195	0.892
(4)	Feeling angry, scared and/or depressed when I think about living with diabetes.	0.733	-0.209	-0.091	0.953	0.739
(6)	Feeling that I am not testing frequently enough my blood sugars.	0.351	-0.018	-0.001	0.357	0.350
(7)	No matter what I do, I feel that I will end up with serious long-term complications.	0.865	-0.116	-0.004	0.952	0.869
(8)	Feeling that I am often failing with my diabetes routine.	0.899	-0.203	-0.037	1.086	0.905
(10)	Feeling that diabetes controls my life.	0.854	-0.246	0.000	1.069	0.862
(12)	Feeling that I am not sticking closely to a good meal plan.	0.527	0.099	-0.196	0.494	0.520
(14)	Feeling overwhelmed by the demands of living with diabetes.	0.914	-0.250	-0.071	1.161	0.921
(16)	Feeling not motivated to keep up self-management about my diabetes.	0.889	-0.194	-0.080	1.084	0.894
Factor 2 (Health professional-related distress)					Pattern Matrix	Structure Matrix
		F1	F2	F3		
(1)	Feeling that my doctor does not know enough about diabetes and diabetes care.	0.340	0.774	-0.337	1.205	0.831
(5)	Feeling that my doctor does not give me clear directions on how to manage my diabetes.	0.375	0.811	-0.293	1.218	0.876
(11)	Feeling that my doctor does not take seriously my concerns.	0.315	0.688	-0.198	1.007	0.871
(15)	Feeling that I do not have a doctor whom I can visit regularly concerning my diabetes.	0.319	0.619	-0.225	0.939	0.759
Factor 3 (Interpersonal distress)					Pattern Matrix	Structure Matrix
		F1	F2	F3		
(9)	Feeling that friends or family do not support enough my self-care efforts.	0.378	0.311	0.831	1.220	0.913
(13)	Feeling that my friends or my family do not appreciate how difficult living with diabetes can be.	0.347	0.263	0.826	1.202	0.872
(17)	Feeling that my friends or my family do not give me emotional support that I would like to have.	0.404	0.241	0.819	1.187	0.896

Notes: Extraction Method: Principal Axis Factoring. Rotation method: Oblimin with Kaiser Normalization.

Table 4. Factor Correlation Matrix.

Factor	Emotional and regimen-related distress	Health professional-related distress	Interpersonal distress
Emotional and regimen-related distress	1.000		
Health professional-related distress	0.652	1.000	
Interpersonal distress	0.643	0.634	1.000

Notes: Extraction Method: Principal Axis Factoring. Rotation method: Oblimin with Kaiser Normalization.

Table 5. Mean, standard deviation (SD), internal consistency (Cronbach's α coefficient) of the Diabetes Distress Scale - Turkish version for patients with type 2 diabetes (n = 170).

Scale	Total items	Range of scores	Mean	SD	α
Emotional and regimen-related distress	10	10-59	21.52	12.24	0.94
Health professional-related distress	4	4-24	10.30	6.58	0.92
Interpersonal distress	3	3-17	4.47	3.57	0.96
Total	17	17-88	36.30	16.73	0.91

management regimens are necessary for healthy life with diabetes, and this may be closely related to the emotional burden. In the study of Polonsky *et al.* (2005), the emotional burden and regime-related distress subscales of the original DDS-17 were highly correlated ($r=0.88$), suggesting that the two subscales were not completely independent [21]. Similar to our study, the Thai DDS-17 validation study conducted in Thailand was a 3-factor model: emotional distress and regime distress were combined as one factor [32]. In addition, in the study of the Chinese population, the three factors for the DDS-17 validation study were an emotional burden, regime- and social support-related distress, and doctor-related distress [17]. It is thought that this difference might be due to the cultural difference in the experience of psychological problems.

Our study among Turkish patients with type 2 diabetes showed high internal consistency of the DDS-17-T (0.91), which is comparable to that of the original DDS-17 (0.93) [19]. This result shows relatively similar internal consistency with results from cross-cultural studies of the DDS-17 scale [17, 18, 32, 33]. The findings from our study suggest that the DDS-17-T is suitable for using in daily clinical practice to identify and assess diabetes distress, especially in patients whose diabetes is poorly controlled.

Limitations

There are some limitations to our study. Firstly, the findings cannot be generalized as the sample was not randomly selected and the data were collected from only one institution. Secondly, the DDS-17-T includes only a sample of patients with type 2 diabetes; it has not been confirmed in patients with type 1 diabetes. Finally, it is worth evaluating whether the scale is sensitive to detecting emotional changes over time.

Conclusions

As diabetes requires strenuous routine care and self-management, it is important to identify and support psychological needs of individuals. The DDS-17-T gives satisfactory results in terms of the translation process and cultural adaptation and has acceptable psychometric properties. In conclusion, the DDS-17-T is a valid and reliable tool to identify diabetes-related distress in patients with type 2 diabetes and to identify the areas of problems. Future studies on larger samples are needed to implement interventions to minimize the burden of diabetes distress among patients with type 2 diabetes.

Ethical Statement

This study had been approved by the Ethics Committee for Clinical Research of the Medical Faculty at a university (Number: 122.AKD Date: 17.02.2016). The written permission was obtained from the Department of Endocrinology and Metabolic Disease in the university hospital. The permission to use the DDS-17 was obtained from William H. Polonsky via e-mail. Both written and verbal consent were obtained from all participants in the study.

The objective of the study was explained to the participants. It was informed that they could leave the study whenever they wanted. All procedures contributing to this work comply with the ethical standards of the relevant national and institutional guidelines and the Declaration of Helsinki.

Informed Consent

Informed consent was obtained from all the patients before they study.

Conflict of Interest

No conflict of interest has been declared by the authors.

Financial Disclosure

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