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Developing a Diabetes Knowledge Scale for Adults and its Psychometric Properties

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ABSTRACT

Objective: This study was conducted to develop and test the psychometric properties of a "Diabetes Knowledge Scale for Adults."

Methods: The sample for this research of methodological design consisted of 500 individuals, ages 18-90, who had presented at a state hospital in Istanbul during the period October 2018-April 2019 with or without a diagnosis of diabetes. Data for the study were collected with a "Sociodemographic Characteristics Descriptive Questionnaire" and the "Diabetes Knowledge Scale for Adults (DKSA)." The validity of the scale was evaluated with the content validity index and construct validity testing (exploratory, confirmatory factor analyses). Its reliability was assessed with KR-20 internal consistency analysis, item-total correlation testing, the item discrimination, item difficulty indexes, and test-retest analysis.

Results: The content validity index for the 28-item scale was found to be 0.92. The exploratory factor analysis revealed five subscales that explained 62.15% of scale variance. The results of the confirmatory factor analysis, GFI= 0.88 CFI= 0.93, AGFI= 0.86, SRMR= 0.01 and $\chi^2/df = 2.43$, confirmed a good and acceptable level of goodness of fit for the scale. The scale's KR-20 reliability coefficient was 0.94, item-total correlations were above .45 and the correlation between the test-retests administered two weeks apart was found to be r=0.99

Conclusion: DKSA is a valid and reliable scale that can be used to determine the knowledge level of between the ages of 18-90 adults about diabetes.

Keywords: Diabetes; knowledge; scale; adult; validity; reliability

1. INTRODUCTON

The rising frequency of diabetes around the world, its prevalence in every age group, its being among the leading five causes of death, and the high cost of lifelong treatment and monitoring makes this disease a global public health issue that has been accepted as an epidemic of the 21st century (1). The International Diabetes Federation (IDF) has reported that there were 463 million individuals with diabetes between the ages of 20-79 around the world in 2019, signifying a prevalence of 9.3%. As in other parts of the world, the prevalence of diabetes is increasing in Turkey as well (2). According to the 2019 Diabetes Atlas, Turkey recorded the highest prevalence of diabetes in Europe, at a rate of 11.1%. Among the 6.6 million people with diabetes in Europe, Turkey has the third highest diabetic population after Germany and the Russian Federation (1). About 60,000 deaths occur as a result of diabetes in Turkey each year, and it is reported that the disease is responsible for approximately one-forth of health expenditure. Additionally, it is asserted that approximately one-third of the country's diabetics are diagnosed with retinopathy and more than half experience at least two diabetes-related complications, meaning that if urgent precautions are not taken, Turkey will be left face-to-face with a diabetes crisis (2-3). All of these data indeed point to a compelling need for urgent measures.

Becoming knowledgeable about the causes of diabetes, the methods of prevention, its signs and symptoms, early diagnosis and treatment options is an effective approach not only for the management of the disease but also for the vital issue of cost efficiency (4-5). About half of individuals with diabetes are not aware of their condition (1,6) The state of having inadequate knowledge about diabetes has an adverse effect on diabetes prevention and self-care behavior (4-5,8). Researchers have reported in various national and international studies that individuals either lack adequate knowledge or possess erroneous or deficient information

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about diabetes (4-8). It is because of this that there is a need to assess the knowledge of individuals about diabetes.

It was seen in the scan of the literature that Fitzgerald et al. had developed a Diabetes Knowledge Test (DKT) that was revised as the Diabetes Knowledge Test 2 (DKT-2) in 2016 DBT-2 is a tool for assessing the general knowledge of both Type 1 and Type 2 diabetics about diabetes; it consists of 14 items with an additional 9 items evaluating the individual's use of insulin, 23 items in all (9). Various tests assessing diabetes knowledge were discovered in the literature (4,8,10,11-12). It was noted that most of these tests were developed and used for individuals who had received a diagnosis of diabetes.

The Turkish literature also revealed that evaluations had generally been made of the knowledge about diabetes of adults who had been diagnosed with diabetes (13). No instrument was encountered in the literature, however, that assessed the diabetes knowledge of individuals who had not been diagnosed with the illness. It was for this reason that the need was recognized for a valid and reliable measure that would assess the level of adults' diabetes knowledge**.** This study aimed to develop a Diabetes Knowledge Scale for Adults (DKSA) that could be easily used to make an assessment.

Research Questions

1. Is the Diabetes Knowledge Scale for Adults a valid instrument?
2. Is the Diabetes Knowledge Scale for Adults a reliable instrument?

2. METHODS

The study was conducted in methodological research design.

2.1. Ethical Considerations

Permission for the conduct of the study was obtained from a University Ethics Committee (04.06.2018-164). The required permissions were also received from the hospital in which the study would be conducted (11.09.2018.556.07146-604.01.01-E.4857) and from the Istanbul Provincial Health Directorate (12.09.2019 – 16867222-604.01.01-E.2752). The written consent of the study participants was received prior to the start of data collection.

2.2. Participants

The study universe consisted of adults presenting for health services at a state hospital located in Eyüpsultan, Istanbul over the period October 2018 – April 2019. During this period, the individuals applying to the hospital were informed about the nature of the study and invited to participate in the research. It is stated in the literature that in scale development studies, the sample must be 10 times the number of scale items (14). In the development and testing of the scale and its psychometric features in our study, the draft of the scale comprised 49 items. The study universe was made up of individuals who matched the inclusion criteria–198 individuals (Group 1: those diagnosed with diabetes) and 302 individuals (Group 2: those not diagnosed with diabetes), totaling 500 (N=500) adults. Of the 302 adults who were not diagnosed with diabetes, 50 had a chronic disease (hypertension, etc.) other than mental or psychological problems, and 252 did not have any health problems. They were healthy individuals who came to the hospital with the patient as a companion. The inclusion criteria were being age 18 or older, not having any barrier to communication, not have a diagnosed neurological, psychiatric or dementia disease, knowing how to read and write, and being willing to participate in the study.

To test the stability of the scale over time, a retest was administered to 30 individuals two weeks after the initial test.

The mean age of the participants was 44.1±17.06; 68.6% were women, 39.6% were diagnosed with diabetes, 10% were diagnosed with a chronic disease other than diabetes, and 50.4% were healthy. According to Body Mass Index (BMI) classification, 2.4% were underweight, 41.8% were of normal weight, 37.8% were overweight and 18.0% were obese (WHO BMI). Among the participants, 65.3% were married; 39.4% had an education of only five years or less, 23.0% had gone to school for 8-11 years, 37.6% had an education of 15 years or more. There was a diagnosis of diabetes in the families of 31.8%.

2.3. Instruments

The study data were collected with a 20-item closed-ended questionnaire on sociodemographic characteristics and routine habits, and the Diabetes Knowledge Scale for Adults (DKSA).

2.4. Creating the Item Pool

The item pool yielded the creation of a 49-item scale based on the literature (9-12,15) in which basic information about the definition of diabetes, symptom findings of diabetes, blood glucose measurement values (laboratory findings), diabetes risk factors, diabetes complications were questioned. This scale items does not include any detailed information about insulin administration, medications, diet, exercise and foot care in type 1 diabetes. While creating the scale item pool on the opinions and suggestions collected from the President of the Diabetes Nursing Association of Turkey, the diabetes nurses working at the hospitals, academic nurses working at the universities, and Physicians Specialized in Internal Diseases. The 49-item scale was sent to a group of experienced specialists, experts in their field, to test its content validity. The data collected from the specialists were tested by using Polit and Beck's content validity index (16). Lastly, a linguist was asked to make an evaluation, after which the draft instrument was given its final form. The draft of the scale was evaluated in a pilot study conducted with 50 adults.

It was seen that the instrument could be administered in 15-20 minutes. It was decided that the data would be collected by the lead researcher in the patient training room of the hospital.

Since the scale was developed to measure knowledge scoring was based on two sets of items whose responses would be true or false. The options of Yes / No / I don't know were given; those who answered correctly were afforded 1 point, those who responded incorrectly were given 0 points. The third and sixth items were scored in reverse. The maximum possible score on the scale was 49; the minimum was 0.

2.5. Statistical Analysis

The data collected were evaluated on the SPSS 22.0 computer program and with the Amos 16 software. The descriptive analysis of the data used frequencies, percentages, means and standard deviation in the testing. Validity analysis was performed using the Content Validity Index (CVI), Kaiser-Meyer-Olkin and Barlett's tests, Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). Reliability analysis was performed using Pearson's and Spearman's correlation analyses, Kuder-Richardson-20 (KR-20) analysis and the item difficulty index. The results were found to be in the 95% confidence interval; the level of significance was accepted to be $p<0.05$.

3. RESULTS

3.1. Results of the Validity Analysis of the Scale

After the opinions of 10 experts were reviewed, it was found that the Content Validity Index was .92.

In the Principal Components Analysis, it was found that the Diabetes Knowledge Scale for Adults demonstrated a Kaiser-Meyer-Olkin (KMO) value of .94, indicating that the sample size was suitable for factor analysis. The result of Bartlett's Test indicated statistical significance (p=.00).

3.2. Exploratory Factor Analysis (EFA)

The results of the varimax rotation analysis showed that the scale could be divided into seven subscales, each with an eigenvalue greater than +1. In the calculation of the factor loadings, it was seen that the factor loadings of all items amounted to .41 and above. The factor analysis showed that according to the item factor loadings (±.20), there were 22 overlapping items (3, 4, 5, 6, 7, 15, 16, 18, 19, 21, 22, 25, 26, 27, 28, 30, 31, 38, 39, 40, 43, 44), and therefore these were removed from the scale (Table 2). After these 22 items were removed, the remaining 28 were subjected to an EFA, which showed that the scale had five subscales that explained 62.15% of total variance (Table 1).

Table 1. *Items Deleted according to the exploratory factor analysis of the diabetes knowledge scale for adults*

No	Item	$\bar{x}$	sd	Rjx	α	α^1
3	Insulin is a hormone secreted by the pancreas.	.496	.500	.654	.361	.385
4	Insulin is a hormone that lowers blood glucose.	.528	.500	.586	.390	.508
5	Type 1 diabetics need to take insulin all their lives.	.312	.464	.515	.308	.471
6	Type 2 diabetics do not need to take insulin all their lives.	.264	.441	.475	.410	.493
7	Diabetes can be seen in pregnancy.	.502	.501	.658	.400	
15	Measuring blood glucose at home is important in the management of diabetes.	.642	.480	.670	.392	.406
16	Exercising helps to lower blood glucose.	.624	.485	.687	.351	.486
19	The risk of diabetes is high in those with diabetes in their family or relatives.	.680	.467	.711	.434	
21	The risk of diabetes is high in the overweight.	.686	.465	.664	.544	.330
22	The risk of diabetes is high in people with an excess of blood lipids.	.490	.500	.594	.302	.340
25	The risk of diabetes is high in people under stress.	.520	.500	.587	.516	
26	Smokers are at high risk of diabetes.	.338	.474	.467	.401	.433
27	People who don't eat a healthy diet are at high risk of diabetes.	.658	.475	.678	.348	.491
28	The risk of diabetes is high in people who live sedentary lives.	.656	.476	.667	.432	.465
30	The risk of diabetes is high in people with hypertension.	.290	.454	.488	.445	.423
31	The risk of diabetes is high in people who have low blood sugar a little while after eating.	.356	.479	.567	.431	.502
38	Widespread itching in the body is one of the symptoms of diabetes.	.362	.481	.525	.324	.407
39	Weight gain or loss is one of the symptoms of diabetes.	.540	.499	.658	.319	.330
40	Fatigue and tiredness is one of the symptoms of diabetes.	.550	.498	.654	.488	
43	If diabetes is not managed well, it can lead to hypoglycemia.	.488	.500	.641	.331	.309
44	If diabetes is not managed well, it can lead to wounds in the feet.	.646	.479	.745	.315	.357

$\bar{x}$=Mean item score, sd= Item standard deviation, rjx=Item-total score correlations, α=Item factor loading, α1=Factor loading when item is removed

***Table 2**. Validity and reliability analyses of the diabetes knowledge scale for adults*

Subscales	Old Item No	New Item No.	DKSA İtems	x̄	sd	rjx	α
General Knowledge About Diabetes (KR-20= (KR20=.789)	1	1	Diabetes means a rise in blood glucose.	.680	.466	.622	.436
	2	2	Diabetes is caused by insulin deficiency or inadequacy.	.594	.496	.590	.499
	8	3	Diabetes is congenital, it does not develop afterwards (Y)	.556	.497	.500	.572
	9	4	Diabetes is a lifelong disease.	.498	.500	.498	.552
	10	5	There is no treatment for diabetes, but the disease can be kept under control.	.560	.491	.584	.708
	11	6	Diabetes is a contagious disease. (Y)	.680	.457	.450	.722
Measuring Blood Glucose and Test Results (KR-20=. .851)	12	7	Fasting blood glucose should be between 70-100 mg/dl.	.486	.487	.737	.800
	13	8	Postprandial blood glucose should be below 140 mg/dl.	.388	.500	.721	.828
	14	9	Postprandial blood glucose should be measured 2 hours after the first bite of the meal.	.474	.464	.657	.730
	17	10	The hemoglobin A1c (HbA1c) count provides data on the level of blood glucose in the last 3 months.	.314	.499	.639	.743
	18	11	A diagnosis of diabetes is made on the basis of a blood glucose of 126 mg/dl or over after at least 8 hours of fasting.	.298	.457	.553	.703
Diabetes risk factors (KR-20= (.744)	20	12	Diabetes risk is high at age 40 and above.	.474	.391	.472	.398
	23	13	The risk of diabetes is high in women who deliver babies of 4 kg and over.	.298	.457	.602	.725
	24	14	The risk of diabetes is high in pregnant women with high blood glucose.	.438	.496	.617	.637
	29	15	The risk of diabetes is high in people who have had an infectious (microbial) disease.	.188	.499	.476	.733
Symptoms of Diabetes (KR-20=. .911)	32	16	Extreme thirst, drinking lots of water is one of the symptoms of diabetes.	.686	.496	.747	.754
	33	17	Frequent urination is one of the symptoms of diabetes.	.632	.460	.790	.923
	34	18	Frequent urination during the night is one of the symptoms of diabetes.	.588	.482	.747	.831
	35	19	Increased appetite, overeating is one of the symptoms of diabetes.	.560	.499	.649	.628
	36	20	Blurred vision is one of the symptoms of diabetes.	.470	.470	.595	.507
	37	21	Slow healing of cuts and wounds is one of the symptoms of diabetes.	.640	.480	.719	.577
	40	22	Fatigue and tiredness is one of the symptoms of diabetes.	.550	.497	.782	.569
	41	23	A dry mouth is one of the symptoms of diabetes.	.670	.492	.782	.759
Complications of Diabetes (KR-20=. .901)	45	24	If diabetes is not managed well, it may cause a deterioration of kidney functions.	.640	.499	.783	.690
	46	25	If diabetes is not managed well, it may cause eye diseases that may even lead to the loss of sight.	.670	.495	.786	.600
	47	26	If diabetes is not managed well, it will cause hypertensive diseases.	.472	.470	.658	.803
	48	27	If diabetes is not managed well, it will cause cardiovascular diseases.	.572	.480	.805	.816
	49	28	If diabetes is not managed well, it will cause loss of body parts (particularly hands and feet).	.612	.487	.741	.556

x̄=Mean item score, sd=standard deviation, rjx=Item-total score correlations, α=Item factor loading,

3.3. Results of Factor Item Analysis of the Subscales

General knowledge about diabetes; this subscale assesses how much general

information an individual has about diabetes and consists of six items, of which two are wrong (3 and 6. item) four are right (1, 2, 4 and 5. item). The factor loadings of the items varied between .43-.72.

Blood glucose measurement values; are indicators of an individual's fasting and

postprandial blood glucose. This sub-dimension is made up of five correct statements (items 7, 8, 9, 10, 11) and the factor loadings of the items varied between .70-.82.

Diabetes Risk Factors; measures an individual's knowledge about their risk of

developing diabetes. This sub-dimension is made up of four statements (items 12, 13, 14, 15). The factor loadings of the factor items varied between .39-.73.

Symptoms of Diabetes; This measures the individual's knowledge of the signs and

symptoms of diabetes. The entire subscale is made up of eight correct statements (items 16,17,18,19,20,21,22 and 23) and the factor loadings of the items varied between .50-.92.

Diabetes Complications; this assesses the individual's knowledge about the detrimental

effects of diabetes on the organs and tissues of the body. The entire subscale is made up of five correct statements (items

24, 25, 26, 27, 28) and the factor loadings of the items varied between .55-.81.

For all sub-dimensions of the scale; the higher the score, the greater the individual's knowledge about the diabetes (Table 2).

3.4. Confirmatory Factor Analysis (CFA)

The confirmatory factor analysis showed that the calculated value of the Chi-Square goodness of fit test was 818.998. Dividing the chi-square value by the degree of freedom yielded 2.43. This value was below three and therefore showed excellent fit. When the other fitness indexes were calculated, the Goodness of Fit Index (GFI) was found to be .93. The Adjusted Goodness of Fit Index (AGFI) was calculated as .86. The Comparative Fit Index (CFI) was .93. The Non-normed Fit Index (NNFI) was .90. A Root-Mean-Square Residual (RMR) of 0.05 or below (.01) indicates excellent fit. The RMSA was found to be .54.

A diagram of the model revealed at the end of the CFA can be seen in Figure 1.

According to the results of the CFA, it was found that all of the items in the scale significantly represented the dimensions they were meant to represent (Figure 1).

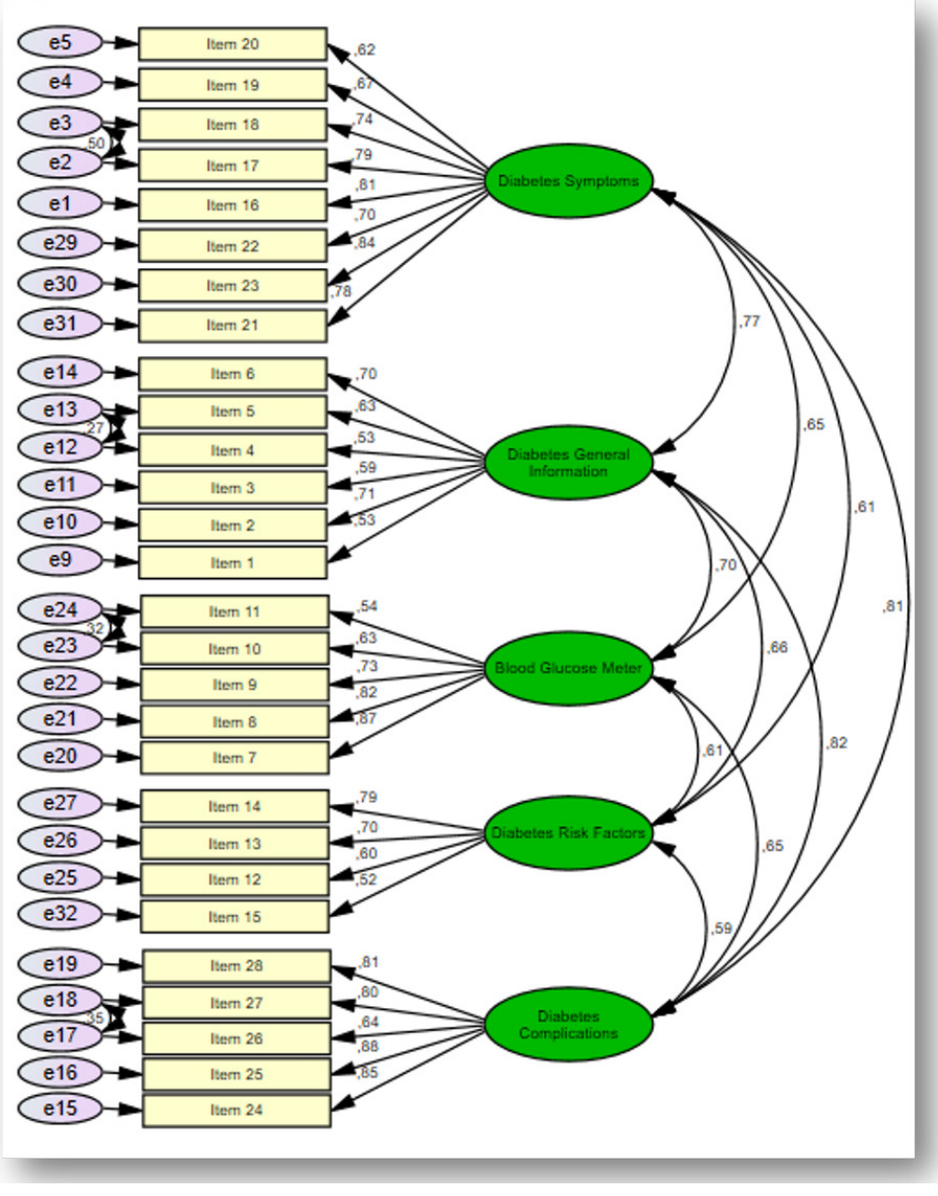

Figure 1. *The Diabetes Knowledge Scale for Adults Path Diagram and Standardized Analysis Results*

3.5. Reliability Analysis Results

A KR-20 reliability coefficient of .94 was found for the overall scale.

In the general diabetes knowledge dimension, the KR-20 alpha value was found to be .78; item-total score correlations varied between .45 and .62.

In the blood glucose measurement dimension, the KR-20 alpha value was .85, item-total correlations varied between .55-.73.

In the diabetes risk factors dimension, the KR-20 alpha value was .74 and item-total correlations varied between .47-.61.

In the diabetes symptoms dimension, the KR-20 alpha value was .91 and item-total correlations varied between .59-.79.

In the diabetes complications dimension, the KR-20 alpha value was .90 and item-total correlations varied between .65-.80 (Table 2).

3.6. Stability over time (test-retest)

Pearson's Correlation Analysis calculated following the retest after two weeks as from the first administration of the test indicated r=.98; p=.00. Statistically, a strong, significant and positive correlation was found between the two measurements.

4. DISCUSSION

At the end of this methodologically designed research, a Diabetes Knowledge Scale for Adults was developed containing 28 items and five subscales for assessing knowledge about diabetes symptoms, general knowledge of diabetes, blood glucose measurements, diabetes risk factors, and diabetes complications. The analyses showed that the scale was valid and reliable.

Content validity and construct validity analyses are the most commonly employed means of testing validity (17). In this study, we tested for content and construct validity (EFA and CFA).

Content Validity Index (CVI): Polit and Beck's (2006) CVI was used in this study (16). The scale items were presented to 10 experts for their views. In this method, the experts are asked to rate each item on the basis of 1-4 with 1 signifying "not appropriate," and 4 meaning "very appropriate." The number of experts rating each item 3 or 4 divided by the total number of raters leads to the calculation of CVI for both the item and the overall scale. For the scale or item to show content validity, CVI must be .80 or above 1(16). Since the scale and its items had CVI values of 0.92, it was concluded that there was a high level of content validity.

Construct validity testing is used to determine what a scale measures and what the scores of the study participants signify. To decide whether the construct validity data are suitable for factor analysis, the Kaiser-Meyer-Olkin (KMO) coefficient is expected to be over .60 and Barlett's test must indicate significance (18). In this study the KMO coefficient was .94, which showed that the sample size was at a very good level for factor analysis (19). Bartlett's test was at a significance level of p=.00, which meant that there was high correlation between the scale variables and the data were of multivariate normal distribution (18,20).

Factor analysis is performed as exploratory and confirmatory factor analysis. Eigenvalues in exploratory factor analysis are used to explain the percentage of factor variance and to decide on the number of subscales (17). In this study, the EFA results showed that the eigenvalue of the scale was greater than +1 and was distributed in seven subscales. It is recommended in exploratory factor analysis that the lower limit on factor loadings is kept at a high level. Because of this, the lower limit for the scale's item factor loadings was kept at .40 and the overlap limit was accepted as – .20 (21). After the factor analysis, 22 items with overlapping factor loadings were removed from the scale and a repeated EFA resulted in 5 subscales and a 28-item scale.

It was seen in the DKSA that was developed that the five factors explained 62.15% of total variance. The high level of variance showed that the scale was able to make a good measurement of the concept.

The factor loading in Exploratory Factor Analysis is represented by a coefficient that explains the relationship of the item with the various factors and is related to sample size; a factor loading of .60 and over is considered a high factor loading regardless of its direction (21). In this study, the item factor loadings were between .39 and .92, pointing to moderate and high factor loading. In this study, the results of the confirmatory factor analysis of DKSA were found to be statistically acceptable.

The data obtained as a result of the confirmatory factor analysis are examined with goodness of fit statistics to find whether or not they acceptably support the model (14, 21).

If dividing one of the goodness of fit statistics, the chi-square value by degree of freedom, as recommended in the literature, results in three or less, this indicates that the model is an excellent fit. Chi-square/degree of freedom in this study came out to 2.43. This indicated an excellent model fit (22).

In terms of other frequently used goodness of fit statistics, a RMSEA value equal or less than .08, a RMR value of less than .10, CFT, NNFI values equal to or greater than .90, an AGFI value equal to or greater than .80 indicates satisfactory fit (23).

The values above the arrows between the factors and items are standardized factor loadings; a statistic of at least .30 or over is recommended (21).

The standardized factor loadings of all of the items in DKSA were found to be in the range of .52-.87 (Figure 1). It was seen accordingly that all of the scale items were related to a subscale and appropriately represented it.

The most commonly used techniques to assess the reliability of a scale are internal consistency (KR 20-21, Cronbach's alpha), item-total score correlations, and test-retest reliability (25).

Internal consistency analysis is performed to assess whether the statements in an instrument are consistent with each other. In internal consistency analysis, the aim is to find out whether the items can measure a specified conceptual construct (14). It is expected that reliable instruments will show a high level of internal consistency. In the literature, the internal consistency coefficient is said to indicate that the scale is not reliable when it is $.00 \leq \alpha < .40$, of low reliability when it is $.40 \leq \alpha < .60$, of satisfactory reliability when it is $.60 \leq \alpha < .80$, and highly reliable when the coefficient is $.80 \leq \alpha < l.0$ (24). The total KR-20 reliability coefficient for DKSA was .94; these values in the subscales varied in the range of .74 – .91 It can be seen that the scale displayed a high degree of reliability. Revised diabetes knowledge scale developed by Colins et al. Cronbach's alpha value is .71. Brief Diabetes Knowledge Test developed by Fitzgerald, et al. (2016) Cronbach's alpha value was found ≥.77. In our study, the Cronbach's alpha value was found to be higher than both studies.

The desired item-total correlation coefficient is a value between .20 – .25 (19). An item-total correlation of .30 and above, it is reported, indicates that the statements can discriminate between individuals (14,18). In this study, the item-total correlation coefficients were above .45 and therefore the analysis indicated that all of the scales were valid tools of measurement.

Item correlations with the total knowledge test score ranged from .23 and .45 on the Revised Diabetes Knowledge Scale. In this study, the item-total correlation (.45) coefficients were above (10).

Assessment of items relative to the item difficulty index: The most frequently used techniques of item analysis are Item Difficulty and Item Discrimination Analyses. The item difficulty index is used when items have more than 1 possible responses (25).

The test-retest method is a way of assessing whether the measurements taken with the same scale are consistent over time (18). Although the variable may change between two measurements according to the particular feature being measured and the sample, it is expected that an interval of two-four weeks is enough to trace a significant correlation between the results; the coefficient should be positive and at least .70 (14). In the present study, there was a statistically positive and strong significant correlation between the two measurements taken of the individuals two weeks apart ($r = .99$; $p = .00$). The strong and positive correlation between the mean scores on the test and retest showed that the scale showed stability over time and reliability was high.

5. CONCLUSION

DKSA is a valid and reliable scale that can be used to determine the knowledge level of between the ages of 18-90 adults about diabetes.

The Adult Diabetes Knowledge Scale, which was developed for the first time in Turkey with this study, and the scale has 28 items and five sub-dimensions. The items of the scale are answered as "Yes", "I don't know", "No". Those who give correct answers receive "1" points, and those who answer incorrectly and "I don't know" receive "0" points. Higher scores indicate higher knowledge about diabetes. DKSA, evaluates the definition of diabetes, basic information about diabetes, diabetes symptom findings, blood glucose measurement values (laboratory findings), diabetes complications.

It might also be suggested that the scale that has been developed can be applied to different samples and in further experimental studies that will shed light on the efficacy of training interventions.

What is the contribution of this article to the application?

- The scale developed in this study was can be used in reducing the physical and moral burden diabetes places on the shoulders of individuals, families and the country, in fighting the global diabetes epidemic, and in increasing awareness in the community about the disease.
- The scale can be applied to healthy individuals at primary care facilities and to those applying to diabetic clinics and can be used as a guide to identify levels of knowledge about diabetes, gaps in knowledge and to facilitate the creation of education programs in this area.
- Scale can be administered before or after training as a pre – and post-test to provide information about the effectiveness of the education.

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