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Developing the Exercise Knowledge Scale in Diabetes

Diyabette Egzersiz Bilgisi Ölçeği'ni Geliştirme Çalışması

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ABSTRACT

Aim: To develop a scale to evaluate exercise knowledge in diabetes and to ensure validity and reliability of scale in Turkish.

Methodology: The question pool prepared on exercise in diabetes. Content validity rates of the scale were between 0.54-1.00. Content validity index of the scale was determined as 0.79.

The pilot application of the first scale with a total of 46 items was carried out with 279 people who had been diagnosed with diabetes. In estimating the aspects of the scale; descriptive analyzes of the scale, construct validity and Cronbach's alpha reliability analysis were performed.

Results: In analysis, it was decided that a total of 21 items should be removed from the aforethought 46-item in the scale. It was observed that the factor loads of the remaining 25 items in the scale ranged from 0.481 to 0.949. It was determined that the structure was explained by 4 factors. Cronbach's alpha coefficient of the scale was found to be 0.943.

Conclusions: 'Exercise Knowledge Scale in Diabetes' with 25 items and a 4-factor structure established its Turkish validity and reliability.

Keywords: Diabetes mellitus, exercise, knowledge, scale

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ÖZET

Amaç: Bu çalışmanın amacı, diyabette egzersiz bilgisini değerlendirmeye yönelik ölçek geliştirip ölçeğin Türkçe geçerliliğini ve güvenilirliğini sağlamaktır.

Gereç ve Yöntem: Diyabette egzersiz konusunda soru havuzu hazırlandı. Ölçeğin, kapsam geçerlilik oranları 0,54-1,00 puan arasındaydı. Ölçeğin kapsam geçerlilik indeksi 0,79 olarak belirlendi.

Toplam 46 maddelik ilk ölçeğin pilot uygulaması, diyabetes mellitus tanısı bulunan 279 kişide gerçekleştirildi. Ölçeğin özelliklerinin kestirilmesinde; ölçeğin tanımlayıcı analizleri, yapı geçerliliği ve Cronbach alfa güvenilirlik analizi yapıldı.

Bulgular: Analizler sonunda 46 maddelik ilk ölçekten toplam 21 adet maddenin çıkartılması gerektiğine karar verildi. Ölçekte kalan 25 maddenin faktör yüklerinin 0,481-0,949 aralığında olduğu gözlendi. Yapının, özdeğeri 1'den büyük olan 4 faktör ile açıklandığı saptandı. Ölçeğin Cronbach alfa katsayısı 0,943 bulundu.

Sonuç: 'Diyabette Egzersiz Bilgisi Ölçeği' 25 maddeli ve 4 faktörlü yapı ile Türkçe geçerliliğini ve güvenilirliğini sağlamıştır.

Anahtar kelimeler: Diyabetes mellitus, egzersiz, bilgi, ölçek

1. Introduction

Diabetes mellitus (DM) is a chronic metabolic disease that develops as a result of insufficient utilization of elements such as carbohydrates, fats and proteins due to the absence or deficiency of insulin [1]. In order to reduce the acute and chronic complications of the disease, patients should be followed up regularly for the rest of their lives and have extensive knowledge about their disease [1, 2].

The development of DM and its complications are closely related with physical inactivity [3]. Physical activity has positive effects such as increasing glycemic control and reducing mortality due to total and cardiovascular risks [3]. In addition to the physical effects of activity, it is also known that it provides positive mental benefits such as reducing depression and anxiety associated with DM [3]. Therefore, DM patients are recommended to participate in physical activity including a combination of aerobic and other exercises that increase muscle strength [3–5].

Individuals diagnosed with DM are recommended to maintain 150 minutes of moderate-intensity or 75 minutes of high-intensity aerobic exercise per week, or a combination of both recommendations. In addition, these individuals should do exercises to increase their muscle strength at least 2 days a week [6, 7]. Since the effect of the exercise lasts for 24-72 hours, it is stated that individuals with DM can take a break from their exercises for a maximum of two consecutive days [4].

On the other hand, in order to prevent hypoglycemia, which can be experienced after exercise in DM patients, certain measures should be taken [6, 8]. These include: adjusting meal-exercise timing, measuring blood glucose before/during/after exercise, taking additional food before exercise according to the measured blood glucose level, or canceling the exercise session until regulation is achieved when blood glucose is above 250 mg/dL, during exercise. In order to prevent hypoglycemia that may be

experienced, people should have foods containing simple sugar with them, choose the insulin injection area and adjust the insulin dose before the planned exercise etc. [1, 6, 9].

The fact that DM is a lifelong insidious disease and may bring with it complications such as delayed wound healing, vascular damage, immune dysfunction, metabolic disorder, high risk of infection, etc. means that additional precautions against these factors should be taken during exercise [10]. For example, it is a fact that the foot, which covers 3.5% of the surface area of the whole body, is of great importance for diabetic patients [10]. Because in terms of nontraumatic amputations, injuries and lesions caused by diabetic neuropathy come first. Thus, it is necessary to take measures to protect foot health in the exercise planning of DM patients [11, 12].

In a specific treatment and follow-up program such as DM patients', it has been revealed that 95% of the success in disease control depends on the patients [13]. Based on this information, it is clear that measurement tools including closed-ended questions (such as yes/no or scales, etc.) that enable health personnel who will provide the necessary information to the patients to quickly evaluate the knowledge level of the patients are needed [14]. According to the results of our literature review, it was determined that there was no specific measurement tool for evaluating exercise knowledge in diabetes. The aim of this study is to develop a scale to evaluate exercise knowledge in diabetes and to ensure the Turkish validity and reliability of the scale.

2. Material and Method

The study began after the approval of the local ethics committee, dated 17/02/2021 and numbered 103. Following a thorough review of the literature on exercise in diabetes in detail, a question pool consisting of 40 items was created. The prepared question pool was sent to 13 academicians (5 sports medicine, 3 endocrinology and metabolism, 3 sports sciences, 1 diabetes nurse, 1 physiotherapy and rehabilitation) to get their expert opinions. It was requested to evaluate the content validity of the question pool with the 3-point Likert type evaluation method prepared in accordance with Lawshe's suggestion [15].

2.1. Content Validity

Since the number of experts who evaluated the question pool was 13, the critical threshold determined for the content validity rate was 0.54 points [15]. In this context, 2 items in the question pool were below 0.54 points. The content validity rates of the other questions were between 0.54-1.00 points. Since the content validity index of the scale was 0.79 and 0.79>0.67, statistical significance was achieved in the scale [15].

Two items below the critical threshold were revised and included in the pilot application according to the feedback from the experts. In addition, 6 new items were added to the question pool used in the pilot application. Thus, the pilot application of the first scale with a total of 46 items was initiated.

2.2. Descriptive Characteristics of the Participants in the Pilot Study

The pilot study was carried out with patients diagnosed with DM who applied to the internal medicine outpatient clinic of our hospital between March and August 2021. The application of the pilot scale, which was prepared in a five-point Likert type structure, was performed using the face-to-face interview technique with a total of 279 people who had been diagnosed with DM for an average of 9.09±8.28 years, of whom 57.3% (n=160) were female and 42.7% (n=119) were male (Table 1). 2.2% (n=6) of the participants were illiterate. 71.3% (n=199) were primary school graduates, 17.2% (n=48) were high school graduates and 9.3% (n=26) were university graduates.

The mean age of the study group was 55.77±13.27 years, body mass index was 30.84±6.42 kg/m^2, waist circumference was 101.90±14.97 cm, systolic blood pressure was 132.20±11.66 mmHg, and diastolic blood pressure was measured as 82.95±6.88 mmHg (Table 1).

92.4% (n=258) of the patients had Type 2 DM, 4.7% (n=13) had Type 1 DM, 2.2% (n=6) had gestational DM and 0.7% (n=2) had DM type associated with single gene disease (Table 1). Those with a history of known disease(s) other than DM were 64.9% (n=181). Among these patients, 48.4% (n=135) had a history of hypertension, 2.7% (n=80) of hyperlipidemia, 16.1% (n=45) of coronary artery disease, 4.7%

(n=13) of hypothyroidism, 1.4% (n=4) of osteoporosis, and 1.4% (n=4) of asthma. 58.4% of the participants (n=163) had history of DM in their family (43.7%, n=104 mother; 25.6%, n=61 father; 30.7%, n=73 sibling).

The regular drug use rate of the patients was found out as 96.4% (n=269). Of these, 40.9% (n=114) were using insulin, 68.5% (n=191) were using metformin, 22.6% (n=63) were using dipeptidyl peptidase-4 (DPP-4) inhibitor, 11.5% (n=32) were using sodium-glucose cotransporter-2 (SGLT-2) inhibitor, 14.7% (n=41) were using sulfonylureas and 2.9% (n=8) were using thiazolidinedione group drugs (Table 1).

The frequency of measurement was 20.91±15.89 times/week in 49.8% (n=139) patients who declared that they had regular blood glucose measurements. Those who said to experience hypoglycemic attacks were 18.6% (n=52), and hypoglycemic attacks were occurring with a frequency of 4.68±4.77 times/month in these patients. The rate of those who developed DM complications was 19% (n=53; 50%, n=35 retinopathy; 35.7%, n=25 neuropathy; 14.3%, n=10 nephropathy).

The rate of those who stated that they had been informed about exercise in diabetes before was 66.7% (n=186). On the other hand, the rate of those who declared that they exercised regularly was 23.3% (n=65). Of these people, 54% (n=35) were exercising alone and 46% (n=30) were exercising in groups. The mean exercise duration of the people who exercise was 4.88±1.49 days/week. It was reported that these people had been exercising regularly for 55.92±76.62 (min: 1 month-max: 480 months) months.

63.4% (n=177) of those ate regular main meals every day, 25.8% (n=72) ate it 3-5 days a week, 7.9% (n=22) ate it 1-3 days a week, those who rarely ate main meals were 2.5% (n=7) and those who never ate were 0.4% (n=1). The rates of those who regularly eat between main meals were found to be 9.7% (n=27), 20.8% (n=58), 37.3% (n=104), 23.3% (n=65) and 9%, (n=25) respectively.

Table 1. Descriptive characteristics of the participants in the pilot study

	Frequency % (n)	**Mean ± SD**	**Min-Max**
Sex			
Female	57.3% (160)		
Male	42.7% (119)		
Age (years)		55.77±13.27	19-91
Body Mass Index (kg/m^2)		30.84±6.42	18.6-64.1
Waist circumference (cm)		101.90±14.97	69-166
Systolic blood pressure (mmHg)		132.20±11.66	90-160
Diastolic blood pressure (mmHg)		82.95±6.88	60-100
Duration of DM (years)		9.09±8.28	0.1-45
DM type			
Type 2	92.4% (258)		
Type 1	4.7% (13)		
Gestational diabetes	2.2% (6)		
DM associated with single gene disease	0.7% (2)		
DM treatment *			
Metformin	68.5% (191)		
Insulin	40.9% (114)		
DPP-4 Inhibitor	22.6% (63)		
Sulfonylureas	14.7% (41)		
SGLT-2 inhibitors	11.5% (32)		
Pioglitazone	2.9% (8)		

DM: Diabetes mellitus, DPP 4: dipeptidyl peptidase 4, SGLT-2: sodium glucose co-transporter 2, *: The number of n exceeds the sample volume. SD: Standard Deviation.

2.3.Statistical Analysis

SPSS v23 package program was used for data analysis. The descriptive information of the participants was determined by descriptive and frequency analysis methods. Content validity ratio and content validity index were calculated to determine the content validity of the items in the scale. In estimating the aspects of the scale; descriptive analyzes of the scale, construct validity and Cronbach's alpha reliability analysis were performed. The relationship between the variables was examined by Pearson correlation analysis. Data were presented as n, % and mean±standard deviation.

3. Results

It was confirmed that the Z score value of the answers given by the participants to the scale were within the range of (-4, +4). Subsequently, construct validity and reliability analyzes were carried out and the findings obtained are given below.

3.1. Construct Validity and Reliability

The construct validity of the scale was examined through factor analysis. Cronbach's alpha coefficient was used to determine the reliability of the scale [15].

It was determined that the hypothesis was met by reaching at least 5 observations (at least n=230) for each item in order to proceed with the explanatory factor analysis process. On the other hand, there was no floor (0.4%) or ceiling (2.2%) effect on the scale scores.

As a result of the item analysis, it was determined that 6 items increased the Cronbach's alpha coefficient, the factor load of 13 items remained below 0.40, and 2 items showed overlapping item characteristics. Hence, it was decided that a total of 21 items should be removed from the aforethought 46-item in the scale.

The correlation coefficients in the Anti-Image Correlation matrix were found to be in the range of 0.829-0.962. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was very good with a score of 0.891. The 'Bartlett's Test of Sphericity' value was calculated as 8216.498 and the p value as 0.0001 and it was determined that the sample was suitable for factoring. The principal component method was used in the factor analysis process, and the 'direct oblimin' method, which is one of the oblique rotation methods, was used in the rotation process. It was observed that the factor loads of the remaining 25 items in the scale ranged from 0.481 to 0.949 (Table 2). According to the scores obtained from the scale, it was determined that the t value of the groups in the top and bottom 27% was not negative and the p value was 0.001. So, item discrimination was achieved (Table 2).

Table 2. Results of Construct Validity

	Items [a]	New Item Number on Scale [a]	Mean	SD	I-T Corr.	IDSI	Rotated Factor Load
F 1	1	1	4.229	0.621	0.617	11.314	0.685
	2	2	3.932	0.868	0.589	11.368	0.861
	3	3	4.129	0.766	0.612	12.305	0.858
	5	4	4.111	0.762	0.670	15.652	0.799
	6	5	4.029	0.729	0.661	15.259	0.767
	7	6	3.892	0.774	0.610	13.341	0.842
F 2	10	7	4.391	0.641	0.593	10.875	0.481
	11	8	4.366	0.631	0.570	10.671	0.498
	12	9	4.201	0.619	0.643	12.232	0.790
	13	10	4.168	0.632	0.642	11.901	0.823
	14	11	4.050	0.766	0.558	11.013	0.678
	15	12	4.111	0.661	0.530	9.758	0.623
	16	13	3.649	0.748	0.527	11.691	0.669
	17	14	3.771	0.728	0.545	11.324	0.561
	18	15	3.738	0.753	0.509	9.503	0.517

F 3	32	16	4.197	0.730	0.660	12.241	0.935
	33	17	4.208	0.724	0.652	11.990	0.949
	34	18	4.208	0.724	0.668	12.433	0.929
	35	19	4.204	0.733	0.659	12.433	0.941
F 4	41	20	4.566	0.564	0.699	13.080	0.804
	42	21	4.548	0.572	0.706	14.338	0.846
	43	22	4.552	0.572	0.695	13.465	0.843
	44	23	4.473	0.687	0.552	10.566	0.849
	45	24	4.516	0.633	0.609	11.842	0.883
	46	25	4.423	0.640	0.663	12.818	0.714

F: Factor, SD: Standard Deviation, I-T Corr.: Item-Total Correlation, IDSI: Item Discrimination Strength Index. [a]: The score given to each item was between 1 and 5.

It was determined that the structure was explained by 4 factors with an eigenvalue greater than 1. The eigenvalue of the 1st factor was 10.833, and the variance rate was 43.334%; The eigenvalue of the 2nd factor was 3.043 and the variance rate was 12.172%, the eigenvalue of the 3rd factor was 2.421 and the variance rate was 9.683%; The eigenvalue of the 4th factor was 1.642 and the rate of variance was 6.566 (Figure 1). Hence, the explained total variance rate of 71.755% was found to be sufficient.

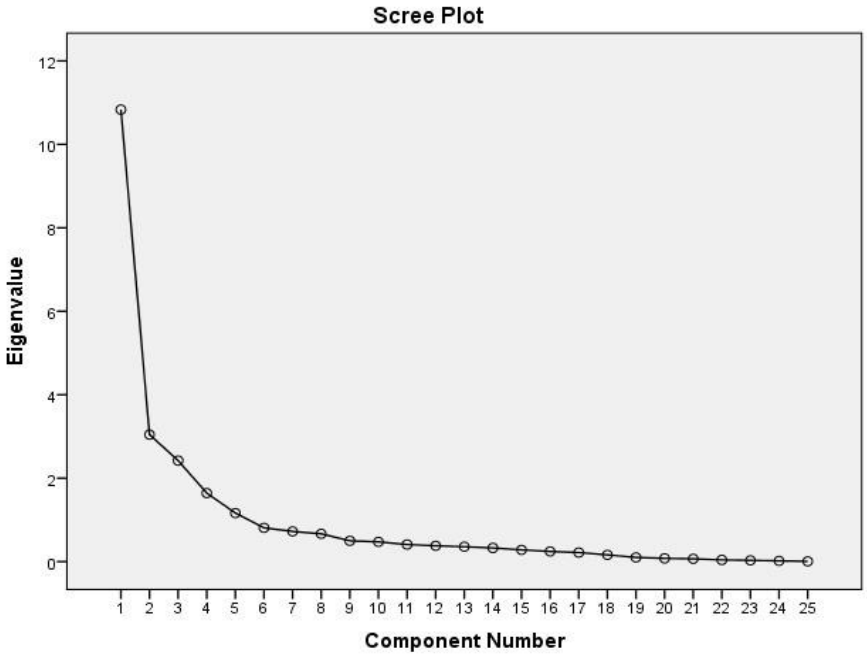

Figure 1: Scree plot graph of the scale

The Cronbach's alpha coefficient of the whole scale and its sub-factors was found to be above 0.80, showing high reliability [15] (Table 3).

It was determined that the sub-scores obtained from the scale showed a positive moderate-strong correlation with each other. Age, as one of the independent variables, was negatively correlated with the scores obtained from the scale, excluding Factor 3 (Table 4).

Thus, the 'Exercise Knowledge Scale in Diabetes' was developed, which has 25 items and a 4-factor structure. Scale items were reordered in accordance with the flow sequence. In order to provide ease of use, the lowest score and the highest score obtained from the scale were readjusted as 0 and 100 respectively (Table 5).

Table 3. Results Regarding The Reliability of the Scale

Factors	Range	Mean	SD	Cronbach's alpha
Factor 1 (Health benefits)	6-30	24.322	3.766	0.909
Factor 2 (Exercise programme)	9-45	36.444	4.383	0.875
Factor 3 (Foot care during exercise)	4-20	16.817	2.886	0.994
Factor 4 (General precautions)	6-30	27.078	3.310	0.953
Scale	25-125	104.663	11.285	0.943

SD: Standard Deviation.

Table 4. Correlation of scale scores with variables

		Factor 1 score	Factor 2 score	Factor 3 score	Factor 4 score	Scale total score
Age	r	**-0.266****	**-0.256****	0.003	**-0.134***	**-0.227****
	p	0.0001	0.0001	0.957	0.025	0.0001
BMI	r	0.029	-0.028	-0.021	0.042	0.006
	p	0.629	0.645	0.724	0.483	0.922
Waist circumference	r	0.007	-0.096	-0.024	0.009	-0.038
	p	0.925	0.165	0.728	0.898	0.581
Systolic BP	r	-0.015	-0.030	-0.071	0.045	-0.021
	p	0.820	0.643	0.276	0.491	0.748
Diastolic BP	r	-0.016	-0.027	0.010	0.078	0.009
	p	0.809	0.678	0.880	0.233	0.886
Diagnosis of DM (years)	r	-0.073	-0.016	-0.011	-0.057	-0.050
	p	0.225	0.785	0.857	0.340	0.403
Glucose measurement frequency/week	r	-0.019	-0.094	0.005	0.116	-0.005
	p	0.822	0.271	0.957	0.172	0.950
Frequency of hypoglycemic attack/month	r	-0.245	-0.009	-0.028	0.055	-0.073
	p	0.076	0.947	0.841	0.694	0.603
Physical activity participation in lifetime/month	r	0.229	0.087	0.287	0.100	0.202
	p	0.150	0.590	0.069	0.534	0.206
Physical activity duration, day/week	r	-0.001	-0.033	0.140	0.107	0.052
	p	0.991	0.792	0.265	0.395	0.679
Factor 1 score	r	1	**0.622****	**0.404****	**0.412****	**0.799****
	p	-	0.0001	0.0001	0.0001	0.0001
Factor 2 score	r	**0.622****	1	**0.429****	**0.511****	**0.856****
	p	0.0001	-	0.0001	0.0001	0.0001
Factor 3 score	r	**0.404****	**0.429****	1	**0.492****	**0.701****
	p	0.0001	0.0001	-	0.0001	0.0001
Factor 4 score	r	**0.412****	**0.511****	**0.492****	1	**0.755****
	p	0.0001	0.0001	0.0001	-	0.0001
Scale total score	r	**0.799****	**0.856****	**0.701****	**0.755****	1
	p	0.0001	0.0001	0.0001	0.0001	-

BMI: Body mass index, BP: blood pressure. *. Correlation is significant at the 0.05 level (2-tailed), **. Correlation is significant at the 0.01 level (2-tailed).

Table 5. Developed 'Exercise Knowledge Scale in Diabetes'

'Exercise Knowledge Scale in Diabetes'

This scale was prepared to measure exercise knowledge specific to diabetes. Please read each statement below carefully. After reading each statement below, give your opinion on 'diabetes specific exercise' by choosing one of the following options:

0. Strongly disagree
1. Disagree
2. Neither agree nor disagree (undecided)
3. Agree
4. Strongly agree

		0	1	2	3	4
1	Regular exercise helps lower blood sugar in people with diabetes.					
2	Regular exercise helps reduce high blood pressure (hypertension) in people with diabetes.					
3	Regular exercise helps reduce harmful blood lipids (bad cholesterol) in people with diabetes.					
4	Regular exercise reduces the risk of developing atherosclerosis in people with diabetes.					
5	Regular exercise reduces the risk of heart attack in people with diabetes.					
6	Regular exercise reduces the risk of stroke in people with diabetes.					
7	People with diabetes should exercise regularly.					
8	Individuals with diabetes should undergo a health check before exercising.					
9	Individuals with diabetes should start exercising at low intensity.					
10	Individuals with diabetes should continue to exercise at moderate intensity.					
11	Individuals with diabetes should warm up before exercise.					
12	Individuals with diabetes should do aerobic exercises (such as walking, cycling, swimming) for at least 30 minutes a day, 5 days a week.					
13	People with diabetes should do muscle-strengthening exercises (such as lifting light weights, stretching a resistance band) 2-4 days a week.					
14	Individuals with diabetes can take a break from their exercise for a maximum of two consecutive days.					
15	Individuals with diabetes should do balance exercises at least 3 days a week to avoid the risk of falling.					
16	Individuals with diabetes-related nerve ending damage (peripheral neuropathy) should check their feet for wounds before exercise.					
17	Individuals with diabetes-related nerve ending damage (peripheral neuropathy) should check for stones, nails, etc. in their shoes before exercise.					
18	Individuals with diabetes-related nerve ending damage (peripheral neuropathy) should check their feet for wounds after exercise.					
19	Individuals with diabetes-related nerve ending damage (peripheral neuropathy) should check for stones, nails, etc. in their shoes after exercise.					
20	Individuals with diabetes should exercise with shoes that are not too tight.					
21	Individuals with diabetes should exercise with shoes that are not loose.					
22	Individuals with diabetes should exercise with shoes that do not come off easily.					
23	Individuals with diabetes should avoid exercising in extremely cold weather.					
24	Individuals with diabetes should avoid exercising outdoors in extremely hot weather.					
25	If people with diabetes do high-intensity exercise without the advice of a doctor, the risk of developing a heart attack increases.					

Explanation: The 'Health benefits' sub-dimension of the scale consists of questions 1-6, 'Exercise programme' sub-dimension 7-15, 'Foot care during exercise' sub-dimension 16-19 and 'General precautions' sub-dimension consists of questions 20-25. The sub-dimension scores and total score of the scale are calculated by adding up the score equivalent of the answers given to each question of the scale. The minimum score is 0 and the maximum score is 100. Higher scores indicate better knowledge.

4. Discussion and Conclusion

The 'Exercise Knowledge Scale in Diabetes' with 25 items and a 4-factor structure established its Turkish validity and reliability. This scale was presented to the use of researchers so that it can be used in the assessment and evaluation of the knowledge level of patients with DM about exercise.

It is important to educate patients and evaluate the effectiveness of the education with valid and reliable measurement tools in lifelong chronic diseases such as diabetes since the progression of the disease depends on the patient's compliance [13]. In this context, the methodological research model proposed for scale development studies was applied in this study, which was developed based on the absence of a measurement tool that can evaluate the exercise knowledge of DM patients [15, 16].

First, a comprehensive question pool was created by the researchers (SE, HK) by reviewing the information in the literature. Since the number of academics whose expert opinion was taken for this study was 13, the critical threshold determined as the content validity ratio of 0.54 was exceeded [15] and the pilot scale provided the scope validity with the feedback given by the expert academicians. Thus, the sample size to which the 46-item first scale should be applied was planned as 230 people, at least 5 times [15] each question, and this number was exceeded during the pilot implementation.

The adequacy of the sample was also tested during the analysis of the answers given to the pilot scale, and the Kaiser-Meyer-Olkin measure of sampling adequacy was found to be 0.891, which indicates a very good level [15] of sampling adequacy. Following these results, the evaluation of the results of the validity and reliability analysis of the scale was carried out.

During the analysis of the items, there was no item with a standard deviation value of 0 and it was determined that the item-whole correlation coefficient values took positive values and remained above 0.5 [15]. However, 6 items that caused an increase in the Cronbach's alpha coefficient when deleted from the scale had to be deleted. Thirteen items with a factor load below 0.40 were excluded from the scale. In addition, it was decided to delete 2 items that were distributed to different sub-factors and showed overlapping item characteristics [15]. Thus, the Cronbach's alpha coefficient of the final version of the scale was found to be 0.943, establishing a high level [15] of reliability.

It is desired that the top and bottom 27% groups, grouped according to the total score in the scales can show distinctiveness. Furthermore, the floor and ceiling effect of the scale, in other words, the rate of same answers given should not be more than 10% [15]. In the study, item discrimination was ensured in accordance with these recommendations and no floor/ceiling effect was observed.

In order to check the construct validity of the scale with factor analysis, it is necessary to determine that the Bartlett Sphericity test p value is below 0.05 and the 'Anti-image' correlation value is above 0.50 [15]. These prerequisites were met in the study and the scale's suitability for factoring was ensured. Following that, the explained variance ratios were calculated with the principal components method, which is one of the most frequently used factor extraction methods. In order for a structure to be accepted as a factor, its eigenvalue should be greater than 1 and the variance rate it explains should be more than 5% [15]. These prerequisites were met for all 4 factors of our scale and the explained total variance rate remained above 70%, thus achieved adequacy [15].

Rotation is recommended in order to prevent the unrotated factor loads obtained by the principal components factor extraction method from being insufficient [15]. In this context, with the correlations between the factors in our scale remaining above 0.32, the rotated factor loads [15] were found by applying 'direct oblimin', which is one of the oblique rotation methods. As a result of this process, it was observed that the factor load of 13 items remained below 0.40 [15] and 2 items had to be deleted from the scale because they were distributed simultaneously to different factors and had overlapping characteristics [15]. Hence, all of the factors in the scale remained above 0.40 and no overlapping items were found.

This research has limitations as it was carried out in a cross-sectional time period and in a single center, with people older than 18 years. It is recommended to check the validity and reliability of this scale with different samples in other geographical regions of Turkey by using it in the follow-up of the prospective patient education processes such as before-after exercise education etc.

According to the information we have obtained from the literature, the validity and reliability of this tool (Appendix), which is the first scale developed to measure exercise knowledge in diabetes, has been established in Turkish. Scale consists of a total of 25 questions in the sub-dimensions of 'Health benefits' (number 1-6), 'Exercise programme' (number 7-15), 'Foot care during exercise' (number 16-19) and 'General precautions' (number 20-25). It would be beneficial to use the scale to measure the knowledge level of DM patients about exercise.

Declaration of Ethical Code

In this study, we undertake that all the rules required to be followed within the scope of the "Higher Education Institutions Scientific Research and Publication Ethics Directive" are complied with, and that none of the actions stated under the heading "Actions Against Scientific Research and Publication Ethics" are not carried out.

The study has approved from the local ethics committee, dated 17/02/2021 and numbered 103.

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Appendix: Original version of 'Exercise Knowledge Scale in Diabetes'

'Diyabette Egzersiz Bilgisi Ölçeği'

Bu ölçek, diyabete (şeker hastalığına) özgü egzersiz bilgisini ölçmek için hazırlanmıştır. Aşağıda yer alan her bir ifadeyi dikkatle okuyunuz. Aşağıda yer alan her bir ifadeyi okuduktan sonra, 'diyabete (şeker hastalığına) özgü egzersiz' konusundaki düşüncenizi;

0. **Kesinlikle katılmıyorum**
1. Katılmıyorum
2. Ne katılıyorum ne katılmıyorum (kararsızım)
3. Katılıyorum
4. Kesinlikle katılıyorum seçeneklerinden sizce uygun olan birini işaretleyerek belirtiniz.

		0	**1**	**2**	**3**	**4**
1	Düzenli yapılan egzersiz, diyabetli bireylerin kan şekerini düşürmeye yardımcı olur.					
2	Düzenli yapılan egzersiz, diyabetli bireylerin yüksek kan basıncını (hipertansiyonunu) düşürmeye yardımcı olur.					
3	Düzenli yapılan egzersiz, diyabetli bireylerin zararlı kan yağlarını (kötü kolesterolünü) düşürmeye yardımcı olur.					
4	Düzenli yapılan egzersiz, diyabetli bireylerde damar sertliği (ateroskleroz) gelişme riskini azaltır.					
5	Düzenli yapılan egzersiz, diyabetli bireylerin kalp krizi geçirme riskini azaltır.					
6	Düzenli yapılan egzersiz, diyabetli bireylerin inme (felç) geçirme riskini azaltır.					
7	Diyabetli bireyler, düzenli olarak egzersiz yapmalıdır.					
8	Diyabetli bireyler, egzersiz yapmadan önce sağlık kontrolünden geçmelidir.					
9	Diyabetli bireyler, egzersize düşük şiddette başlamalıdır.					
10	Diyabetli bireyler, egzersize orta şiddette devam etmelidir.					
11	Diyabetli bireyler, egzersiz öncesinde ısınma hareketleri yapmalıdır.					
12	Diyabetli bireyler; günde en az 30 dakika, haftada 5 gün aerobik (yürüyüş, bisiklet sürme, yüzme gibi) egzersizler yapmalıdır.					
13	Diyabetli bireyler, haftada 2-4 gün kas kuvvetlendirici (hafif ağırlıkları kaldırma, egzersiz lastiği esnetme gibi) egzersizler yapmalıdır.					
14	Diyabetli bireyler, egzersizlerine en fazla ardışık iki gün ara verebilir.					
15	Diyabetli bireyler, düşme riskinden korunmak için haftada en az 3 gün denge egzersizi yapmalıdır.					
16	Diyabete bağlı sinir ucu hasarı (periferik nöropati) olan bireyler, egzersiz öncesinde her iki ayağının her yerinde yara yokluğunu kontrol etmelidir.					
17	Diyabete bağlı sinir ucu hasarı (periferik nöropati) olan bireyler, egzersiz öncesinde ayakkabılarında taş, çivi vb. yokluğunu kontrol etmelidir.					
18	Diyabete bağlı sinir ucu hasarı (periferik nöropati) olan bireyler, egzersiz sonrasında her iki ayağının her yerinde yara yokluğunu kontrol etmelidir.					
19	Diyabete bağlı sinir ucu hasarı (periferik nöropati) olan bireyler, egzersiz sonrasında ayakkabılarında taş, çivi vb. yokluğunu kontrol etmelidir.					
20	Diyabetli bireyler, ayaklarını sıkmayan ayakkabı ile egzersiz yapmalıdır.					
21	Diyabetli bireyler, ayaklarına bol gelmeyen ayakkabı ile egzersiz yapmalıdır.					
22	Diyabetli bireyler, ayaklarından kolay çıkmayan ayakkabı ile egzersiz yapmalıdır.					
23	Diyabetli bireyler, aşırı soğuk havalarda egzersiz yapmaktan kaçınmalıdır.					
24	Diyabetli bireyler, aşırı sıcak havalarda açık havada egzersiz yapmaktan kaçınmalıdır.					
25	Diyabetli bireyler, doktor önerisi olmadan yüksek şiddette egzersiz yaparsa kalp krizi gelişme riski artar.					

Açıklama: Ölçeğin 'Sağlık yararları' alt boyutu 1-6 numaralı, 'Egzersiz programı' alt boyutu 7-15 numaralı, 'Egzersiz seansında ayak bakımı' alt boyutu 16-19 numaralı ve 'Genel önlemler' alt boyutu 20-25 numaralı sorulardan oluşmaktadır. Ölçeğin her bir sorusuna verilen cevabın puan karşılığı toplanarak ölçeğin alt boyut ve ölçek toplam puanı hesaplanır. Ölçekten en az 0, en fazla 100 puan alınabilir. Puanın artması bilgi düzeyinin arttığını ifade etmektedir.