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Validity and Reliability Study of the Turkish Version of the Michigan Revised Diabetes Knowledge Test and Its Relationship with the Turkish Health Literacy Scale-32 Scores

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Abstract

BACKGROUND/AIMS: Education is essential in patients with diabetes to prevent acute and/or chronic complications that may develop over time due to diabetes. This studyaimed to examine the relationship between diabetes knowledge level and health literacy (HL) level of patients by testing the validity and reliability of the Turkish version of the revised Diabetes Knowledge Test-2 (Tr-DKT2).

MATERIALS AND METHODS: A total of 148 patients with insulin-using diabetes were included in our study. Türkiye Health Literacy Scale-32 (THLS-32) and after the determination of the validity of the language and content of the Michigan revised DKT2, it was applied to the patients. The internal consistency of DKT2 was calculated using the Kuder-Richardson-20 (KR-20) formula. The construct validity of DKT2 was examined by testing the validity of known groups and the relationship between it and the THLS-32 score.

RESULTS: A moderate, positive correlation was found between the mean scores on the total THLS-32 and DKT2 (r=0.378). Regarding the test-retest reliability, the intraclass correlation co-efficient value for the total score was found to be 0.893 (95% confidence interval: 0.841-0.928), which was evaluated to be a high value. The internal consistency co-efficient was found to be 0.70 for DKT2. The KR-20 value was calculated as 0.72 for the general test dimension and 0.68 for the insulin use dimension.

CONCLUSION: The Turkish version of DKT2 is a valid and reliable measurement tool. We think that as the HL levels of the patients increase, the diabetes patients will manage diabetes well as their diabetes knowledge level increases.

Keywords: Diabetes education, diabetes mellitus, health literacy

INTRODUCTION

Diabetes mellitus (DM) is a chronic disease that develops because of insulin deficiency or defects in insulin action and requires constant medical care. According to the data of the International Diabetes Federation, there were 463 million individuals with diabetes worldwide in 2019, and this number is estimated to rise to 700 million by 2045.[1] The prevalence of diabetes is increasing in our country as well as in the world. It is necessary to raise awareness among people about the causes of diabetes, facilitating factors, and early diagnosis and treatment.

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The most important step in raising awareness is education. Diabetes can be prevented or delayed by lifestyle changes. Society will be more easily guided to lifestyle changes through education programs after this awareness has been achieved. Good control and education are essential to prevent complications that may develop over time in DM.

Health literacy (HL) is the ability of an individual to acquire, understand, evaluate, and apply health-related information so that he or she can make effective and appropriate health decisions.[2,3] Seeing the course of chronic diseases such as diabetes, preventing negative health outcomes, and helping patients develop self-care skills are closely related to patients' health and diabetes literacy.[4,5] Achieving positive results throughout the illness of patients with diabetes is largely achieved through effective communication related to the treatment of the disease. It is necessary to evaluate both patients' diabetes and their general HL to strengthen their communication with patients.

This study was conducted to create a Turkish version of the Revised Diabetes Knowledge Test-2 (DKT2), test its validity and reliability, and examine the relationship between patients' diabetes knowledge and HL levels.

MATERIALS AND METHODS

The Type and Sample of the Study

This is a cross-sectional and methodological study. The study was conducted between November 2018 and December 2018 in the endocrinology polyclinic of Hitit University Çorum Erol Olçok Training and Research Hospital. Permission from Dr. James T. Fitzgerald, who is a Professor at the University of Michigan Medical School Geriatric Research Education and Clinical Center and who developed the original form of the DKT2, was obtained via e-mail to evaluate the Turkish validity and reliability of the scale. At the outset, the approval of the Hitit University Non-interventional Research Ethics Committee (approval number: 2019-14, date: 04.01.2019) was obtained. Patients who were aged >18 years, were literate, spoke Turkish as their mother tongue, used insulin, and had been followed for at least 1 year because of type 1 or type 2 diabetes were included in the study. The study included 148 patients who met the inclusion criteria. The retest procedure was applied to 100 patients in the sample who agreed to undergo the test for a second time. All patients signed a voluntary consent form and completed the descriptive information form.

Data Collection Tools and Implementation of the Study

The data collection form consisted of three parts. The first part had 20 questions about descriptive characteristics, such as gender, age, educational status, and diabetes-related data, such as chronic complications, hemoglobin A1c (HbA1c) levels, and the status of having received diabetes education. The second part consisted of the Turkish version of the 23-item DKT2, and the third part consisted of the Turkish Health Literacy Scale-32 (THLS-32), whose Turkish validity and reliability study had been previously tested.

Turkish Health Literacy Scale-32

The Turkish validity and the reliability study of the THLS-32 was conducted based on the European Health Literacy Scale. This scale consists of 32 items, and the Cronbach's alpha co-efficient was found to be 0.927. Scores on the scale range between 0 and 50, and high scores indicate a high level of HL. The relationship of scores with literacy levels is interpreted as follows: 0 and 25, "inadequate"; 26-33, "problematic (limited)"; 34-42, "adequate"; 43-50, "excellent".

Diabetes Knowledge Test-2

Revised by the Michigan Diabetes Research Education Center, this test consists of 23 questions that measure diabetes knowledge. The first 14 questions of the scale were designed for patients with diabetes using oral antidiabetic drugs (OAD); however, the entire scale can be applied to patients who use insulin. The test includes the following topics: the first 14 questions are about diet, metabolic tests, complications of diabetes, and exercise. The last nine questions are about insulin and insulin administration. Each question has only one correct answer. The scale score can be obtained by calculating the percentage of correct answers given to the sub-dimensions and the total scale or by summing the scores assigned to each correct response. The alpha reliability co-efficient was 0.77 for the general knowledge test and 0.84 for the insulin use sub-dimension.[6]

Evaluation of the Turkish Validity and Reliability of the Diabetes Knowledge Test-2

First, the Turkish version of DKT2 (Tr-DKT2) was created to evaluate the level of diabetes knowledge in the study. In the process of translating and culturally adapting DKT2 into Turkish, translation-back translation and expert opinion methods defined in the language and cultural adaptation guidelines of Beaton et al.[7] were used. A committee of experts, consisting of two education scientists with an endocrinology background who had a good command of English, evaluated the translated texts and finalized the Turkish version of the scale. To test the intelligibility of the Turkish version, Tr-DKT2 was administered to 20 volunteer patients who presented to the outpatient clinic and met the inclusion criteria, under the observation of the researcher. The patients were asked to evaluate the intelligibility of the scale items by responding with one of the following options: "intelligible", "unintelligible", or "undecided". The responses obtained in the pilot study indicated that none of the items required any changes. In this study, the scale score was obtained by calculating the percentage of correct answers. Reliability was evaluated using internal consistency and test- retest reliability. Internal consistency was tested by calculating the reliability co-efficient Kuder-Richardson-20 (KR-20).[8-10] Test- retest reliability was evaluated using the intraclass correlation co-efficient (ICC). The construct validity of the scale was evaluated using criterion validity, and the Spearman correlation level between education levels and scale scores was calculated.

Statistical Analysis

Study data were analyzed using the SSPS 23.0 statistical software package. Descriptive statistics were presented using numbers and percentages for categorical variables and mean ± standard deviation and median (minimum-maximum values) values for continuous variables. The normality of continuous variables was evaluated using visual (histogram and probability graphs) and analytical methods (Kolmogorov-Smirnov/Shapiro-Wilk tests). It was determined that the Tr-DKT2 scores did not show a normal distribution. The relationship between the scale scores was evaluated using the Spearman correlation test. In this study, $p<0.05$ was considered statistically significant.

RESULTS

Turkish Validity and Reliability Results of the Diabetes Knowledge Test-2

To test the Turkish intelligibility of Tr-DKT2, which was created according to the language and cultural adaptation guidelines of Beaton et al.[7], it was applied to 20 volunteer patients in the outpatient clinic, and then it was finalized. Afterward, the questionnaire, which was applied to 148 patients in the first test, was applied to 100 patients in the sample for the second time with an average of 15.9±5.3 (minimum: 7-maximum: 30) days interval. Test- retest reliability was calculated as ICC 0.893 (95% CI: 0.841-0.928) for the total DKT2, ICC 0.826 (95% CI: 0.741-0.883) for the general knowledge test, and ICC 0.801 (95% CI: 0.704-0.866) for the insulin use sub-dimension. The internal consistency co-efficient was found to be 0.70 for DKT2, KR-20=0.72 for the general test, and KR-20=0.68 for the insulin use sub-dimension. Education levels and the Spearman correlation co-efficient were evaluated for the construct validity of the scale, and a moderate correlation was found (r=0.364; p<0.001). There was a weak, statistically significant relationship between education level and the general test and insulin use sub-dimension scores (r=0.286 p=0.004 and r=0.292 p<0.001, respectively). The median DKT score was 65.2 (34.7-95.6) for primary school graduates, 73.9 (43.4-100) for secondary school graduates, and 78.2 (43.4-95.6) for university graduates, and there was a statistically significant difference between them (p<0.001). Considering these results, it was shown that DKT2 is a valid and reliable scale. The Turkish version, which was found to be valid and reliable after the analyzes, is presented in Figure 1.

Demographic Data and Clinical Characteristics of the Patients

A total of 148 patients with diabetes, 86 males and 62 females, were included in the study, and their mean age was 47.5±13.8 (minimum: 18; maximum: 77) years. The mean body mass index was 30.7±6.89 (19.4-54.9) kg/m^2, and only 29 (19.6%) patients had a normal weight. The examination of patients' distribution according to their education level indicated that 74 (50%) were primary school graduates, 39 (26.4%) were secondary school graduates, and 35 (23.6%) were university graduates. Of the patients, 96.0% did not live alone, and 13 patients (8.8%) stated that they lived with a healthcare worker (Table 1). The mean duration of diabetes diagnosis was 11.7±7.5 (1-35) years, and 46.6% of the patients had been diagnosed with hypertension. The examination of diabetes-related complications showed that 60.8% of the patients had at least one minor or macrovascular complication. The most common complication was neuropathy (with; 34.5%), followed by coronary artery disease (23.6%), nephropathy (22.3%), and retinopathy (7.4%). While 66.9% of the patients had been using OAD and insulin, 33.1% had been using only insulin. It was observed that patients using insulin had been using it for an average of 7.74±6.77 (1-30) years and 45 patients (30.4%) for more than 10 years. Hospitalizations were mostly due to hyperglycemia (Table 2). In Table 3, the laboratory values of the patients' last controls are presented. As seen in the table, the patients' mean creatinine level was 1.01±1.08 (0.2-7.8) mg/dL, and the mean HbA1c level was 8.6±2% (5-17.6). The HbA1c level was <7.5 in 45 patients (30.4%), 7.5-9 in 54 patients (36.5%), and ≥9 in 49 patients (33.1%). The low-density lipoprotein cholesterol level was <100 mg/dL only in 37.6% of patients. The triglyceride level was <150 mg/dL in 54.1% of patients, 150-499 mg/dL in 43.9%, and ≥500 mg/dL in 2%.

Relationship between Patients' Health Literacy and Diabetes Knowledge Levels

In this study, patients scored an average of 31.4±7.95 (11-49) on the T-HLS-32. Accordingly, HL levels were inadequate in 23% of patients, limited problematic in 39.2%, adequate in 26.4%, and excellent in 11.4%. The DKT2 scores comprised two parts: general test and insulin use. Patients were found to correctly answer an average of 10.1±2.06 (5-14) questions from the general test, an average of 6.16±1.61 (2-9) questions from the insulin use section, and an average of 16.3±3.08 (8-23) questions from the total test. It was determined that patients' knowledge was 72.3±14.7 percent (35.7-100%) on the general test, 68.4±17.9 percent (22.2-100%) on insulin use, and 70.8±13.4 percent (34.7-100) on the total test (Table 4). A moderate-level, positive correlation was found between THLS-32 and DKT2 scores (r=0.378). Accordingly, patients with a high THLS-32 score also had high DKT2 scores (Table 5). In addition, patients with inadequate/problematic limited HL levels had a median DKT score of 67.3 (34.7-100), and those with adequate/excellent HL levels had a median DKT score of 76.1 (52.1-95.6). Accordingly, a statistically significant difference was found between the groups (p<0.001).

DISCUSSION

In this study, we tested the Turkish validity and reliability of the DKT2 and evaluated the correlation between HL and diabetes knowledge level in patients with diabetes. The findings showed that patients with high HL levels also had high diabetes knowledge levels. This result shows the notion that diabetes education and HL are significant factors in improving patients' ability to manage their health conditions.

The DKT2 is a quick and cost-effective method to assess the general diabetes and diabetes self-care knowledge of patients with diabetes.[6] The results of the study indicated that the Turkish DKT2 scale is an appropriate, valid, and reliable test for patients with diabetes living in Türkiye. It is also a short and intelligible test in terms of application. The first 14 questions of the test were used to measure the general diabetes knowledge level of all patients with diabetes. When previous validity and reliability studies in the literature were examined, it was seen that only the validity and reliability of this 14-item general dimension were tested in some countries.[11-13] The internal consistency value calculated for the general knowledge dimension in these studies ranged from 0.6 to 0.75. In the revision study of DKT2 by Fitzgerald et al.[6], this value was found to be 0.77 for the general test dimension and 0.84 for the insulin use dimension. In our study, the internal consistency co-efficient was 0.72 for the general test sub-dimension, 0.68 for the insulin use sub-dimension, and 0.7 for the total scale. These internal consistency levels were found to be adequate. The reliability level of the Turkish version that we created was consistent with the literature in terms of internal consistency.

This study was initiated on November 2018. Since there was no DKT developed to measure the diabetes knowledge of patients in Türkiye or published in a Turkish validity-reliability study until the start of the study, the author of the test, Fitzgerald, was contacted via e-mail, and the necessary permission was obtained to use the test in the study and to test the validity and reliability of the Turkish version. During this process, İdiz et al.[14] also tested the Turkish version of the revised DKT2, which was created for their sample, and published the results in 2020.

Michigan Diyabet Araştırma ve Eğitim Merkezi Revize Diyabet Bilgisi Testi Türkçe Versiyonu (Tr-DBT-2)

1. Diyabet diyeti:
   a. Çoğu insanın yemek yeme şeklidir.
   b. Çoğu insan için sağlıklı bir diyettir.*
   c. Çoğu insan için çok fazla karbonhidrat içerir.
   d. Çoğu insan için çok fazla protein içerir.
2. Aşağıdakilerden hangisinin karbonhidrat içeriği en yüksektir?
   a. Fırında tavuk
   b. Kaşar peyniri
   c. Fırında patates*
   d. Fıstık ezmesi
3. Aşağıdakilerden hangisinin yağ içeriği en yüksektir?
   a. Düşük yağlı (%2) süt*
   b. Portakal suyu
   c. Mısır
   d. Bal
4. Aşağıdakilerden hangisi bir "besin değeri düşük yiyecektir?
   a. Herhangi bir şekersiz yiyecek
   b. Etiketinde "yağsız" yazan herhangi bir yiyecek
   c. Etiketinde "şekersiz" yazan herhangi bir yiyecek
   d. Kalorisi, porsiyon başına 20 kaloriden az olan yiyecekler*
5. A1C, geçtiğimiz ……. için ortalama kan şekeri düzeyinizin ölçüsüdür.
   a. Bir gün
   b. Bir hafta
   c. 6-12 hafta*
   d. 6 ay
6. Evde şeker testi için en iyi yöntem hangisidir?
   a. İdrar testi
   b. Kan testi*
   c. Her ikisi de eşit derecede iyidir.
7. Şeker ve benzeri madde içermeyen meyve suyunun kan şekeri üzerindeki etkisi nedir?
   a. Düşürür.
   b. Yükseltir.*
   c. Etkisi yoktur.
8. Hangisi düşük kan şekeri tedavisinde kullanılmamalıdır?
   a. 3 adet küp şeker
   b. ½ bardak portakal suyu
   c. 1 bardak alkolsüz diyet içecek*
   d. 1 bardak yağsız süt
9. Diyabeti iyi seviyede kontrole sahip bir kişi için egzersizin kan şekeri üzerindeki etkisi nedir?
   a. Kan şekerini düşürür.*
   b. Kan şekerini yükseltir.
   c. Etkisi yoktur.
10. Kan şekeriniz düşmeye başlıyorsa hangisini yapmanız gerekir?
    a. Egzersiz
    b. Yatmak ve dinlenmek
    c. Biraz meyve suyu içmek*
    d. Hızlı etki gösteren insülin almak
11. Enfeksiyonun kan şekeri üzerindeki en olası etkisi nedir?
    a. Kan şekerini düşürür.
    b. Kan şekerini yükseltir.*
    c. Etkisi yoktur.
12. Hangisi ayak bakımı yapmanın en iyi yoludur?
    a. Her gün ayaklarınıza bakmak ve yıkamak.*
    b. Her gün ayaklarınıza alkolle masaj yapmak.
    c. Her gün bir saat suda bekletmek.
    d. Normalden bir numara büyük ayakkabı almak.
13. Az yağlı yiyecekler yemek hangi riski azaltır?
    a. Sinir hastalıkları
    b. Böbrek hastalıkları
    c. Kalp hastalıkları*
    d. Karaciğer hastalıkları
14. Uyuşma ve karıncalanma hangisinin semptomları olabilir?
    a. Böbrek hastalıkları
    b. Sinir hastalıkları*
    c. Göz hastalıkları
    d. Karaciğer hastalıkları
15. Hangisi genellikle diyabetle ilişkili değildir?
    a. Görme problemleri
    b. Böbrek problemleri
    c. Sinir problemleri
    d. Akciğer problemleri*
16. Hangisi ketoasidoz (DKA) belirtisidir?
    a. Titreme
    b. Terleme
    c. Kusma*
    d. Düşük kan şekeri
17. Eğer gribe yakalanmışsanız, yapmanız gereken
    a. Daha az insülin almaktır.
    b. Daha az sıvı almaktır.
    c. Daha fazla proteinli yemektir.
    d. Kan şekerinizi daha sık ölçmektir.*
18. Hızlı etki gösteren insülin aldıysanız, kan şekeri düşmesini en olası hangi zamanda yaşarsınız?
    a. 2 saatten daha kısa sürede*
    b. 3-5 saat arasında
    c. 6-12 saat arasında
    d. 13 saatten fazla bir zamanda
19. Tam öğle yemeğinden önce, kahvaltıda insülin almayı unuttuğunuzu fark ettiniz. Şimdi ne yapmalısınız?
    a. Kan şekerinizi düşürmek için öğle yemeğini atlamalısınız.
    b. Genellikle kahvaltıda aldığınız insülini almalısınız.
    c. Genellikle kahvaltıda aldığınız insülinin iki katı kadar insülin almalısınız.
    d. Ne kadar insülin almanız gerektiğine kara vermek için kan şekerinizi kontrol etmelisiniz.*
20. Kan şekerinin düşmesi hangisinden kaynaklanıyor olabilir?
    a. Çok fazla insülin*
    b. Çok az insülin
    c. Çok fazla yiyecek
    d. Çok az egzersiz
21. Eğer sabah insülininizi alır fakat kahvaltıyı atlarsanız, kan şekeri düzeyiniz genellikle
    a. Yükselir.
    b. Düşer.*
    c. Aynı kalır.
22. Kan şekerinin yükselmesi hangisinden kaynaklanıyor olabilir?
    a. Yetersiz insülin*
    b. Yemekleri atlamak
    c. Ara öğünü geciktirmek
    d. Egzersizinizi atlamak
23. Kan şekerinin düşmesi hangisinden kaynaklanıyor olabilir?
    a. Ağır egzersiz*
    b. Enfeksiyon
    c. Aşırı yeme
    d. İnsülininizi almama

Figure 1. The Turkish version of Tr-DKT-2, which was found valid and reliable.

DKT-2: Diabetes Knowledge Test-2.

In this study, the reliability co-efficient calculated with ∝ for the first part of DKT2 was 0.60 for the general test sub-dimension, ∝=0.59 for insulin use, and ∝=0.70 for the total scale.[14] It is noteworthy that the internal consistency level was below the critical value of 0.6 for the insulin use dimension.

Diabetes education is effective in improving the clinical outcomes and quality of life of patients.[15] The role of patient education in diabetes has been emphasized in many studies.[16-18] Therefore, patients with diabetes need to be aware of the disease and its management to achieve good metabolic control. However, some studies have shown that approximately 50-80% of patients with diabetes have a significant lack of knowledge and skills.[19] In the study by Fitzgerald et al.[6], the mean test score in patients with type 1 diabetes was 84.7±20% for the general test and 84.9±24.1% for insulin use, and the scores in patients with type 2 diabetes were 71.7±24.7% and 64.3±28.4%, respectively.[11] In our study, the scores were 72.3%±14.7% and 68.4%±17.9% in all patients This finding shows that the education levels and diabetic education levels of the patients in the two study groups were similar.

According to the data obtained in the study, the HL level was inadequate or limited in 62.2% of the patients. This indicated that patients' ability to effectively use health services and health-related information was limited. On the other hand, when patients' diabetes knowledge level was examined, the mean correct knowledge level was 72.3% for the

Table 1. Some demographic characteristics of the patients

Parameters, (n=148)	
Gender, n (%)	
Male	86 (58.1)
Female	62 (41.9)
Age, year	
Mean ± SD	47.5±13.8
Median (minimum-maximum)	48.5 (18-77)
BMI, kg/m²	
Mean ± SD	30.7±6.8
Median (minimum-maximum)	29.3 (19.4-54.9)
BMI classification, n (%)	
18.5-24.9 (normal weight)	29 (19.6)
25-29.9 (overweight)	55 (37.2)
30-34.9 (class 1 obesity)	32 (21.6)
35-39.9 (class 2 obesity)	17 (11.5)
≥40 (class 3 obesity)	15 (10.1)
Level of education, n (%)	
Primary education	74 (50.0)
Secondary education	39 (26.4)
University and above	35 (23.6)
Marital status, n (%)	
Married	124 (83.8)
Single	16 (10.8)
Widowed	8 (5.4)
Households, n (%)	
None	6 (4.1)
Spouse and children	124 (83.8)
Other	18 (12.2)
Living with a healthcare worker, n (%)	
No	135 (91.2)
Yes	13 (8.8)
Monthly family income, n (%)	
Low	69 (46.6)
Middle	74 (50.0)
High	5 (3.4)

*: Row percentage, SD: Standard deviation, BMI: Body mass index.

Table 2. Patient characteristics related to DM

Parameters, (n=148)	
Duration of DM, year	
Mean ± SD	11.7±7.5
Median (minimum-maximum)	10 (1-35)
Duration of DM, n (%)	
≤5 years	31 (20.9)
6-10 years	52 (35.2)
11-20 years	48 (32.4)
≥21 years	17 (11.5)
Complications of DM, n (%)	
No	58 (39.2)
Yes	90 (60.8)
Complications of DM, n (%)*	
Nephropathy	33 (22.3)
Neuropathy	51 (34.5)
Retinopathy	11 (7.4)
Coronary artery disease	35 (23.6)
Foot ulcers	3 (2.0)
Amputation	2 (1.4)
Treatment for DM, n (%)	
OAD + insulin	99 (66.9)
Insulin	49 (33.1)
Duration of insulin use, year	
Mean ± SD	7.7±6.7
Median (minimum-maximum)	6 (1-30)
Duration of insulin use, n (%)	
<10 years	103 (69.6)
≥10 years	45 (30.4)
Hospitalization in the past year, n (%)	
No	135 (91.2)
Once	13 (8.8)
Length of hospitalization (n=13), day	
Mean ± SD	6.1±4.8
Median (minimum-maximum)	5 (1-20)
Indiciations for hospitalization (n=13), n (%)	
Hyperglycemia	11 (84.6)
Hypoglycemia	1 (7.7)
Diabetic ketoacidosis	1 (7.7)

*: Multiple options were marked, DM: Diabetes mellitus, SD: Standard deviation, BMI: Body mass index, OAD: Oral antidiabetic drugs.

general test and 68.4% for insulin use. These rates suggested that patients had basic knowledge about diabetes but needed more detailed health knowledge and skills. In the study by Bains and Egede[20], a moderate correlation was found between HL and diabetes knowledge (r=0.44). Similarly, a moderate correlation was found in our study. In addition, similar correlations have been found between limited HL and poorer disease knowledge in the literature.[21-23]

When the patients' education level was examined, it was seen that 50% of them were primary school graduates, 26.4% were secondary school graduates, and 23.6% were university graduates. In this study, it can be said that the level of diabetes knowledge increased with the increase in education level (r=0.364; p<0.001). In a study conducted in Saudi Arabia, similar to our study, it was found that the level of diabetes knowledge increased as the education level increased.[24]

Study Limitations

DKT2, the validity and reliability of which was tested in our study in Turkish, was designed to measure the knowledge level of patients with diabetes. The scale was created by focusing on knowledge areas related to the general management of diabetes and insulin use. However, dimensions such as long-term effects, nutrition, exercise, and blood sugar control, which are other important issues of diabetes, are not included in the scale. There may be some questions about these issues, but they are not considered among the main dimensions of the scale. While this underlines that we found the Turkish version of DKT2 to be valid and reliable in our study, it also reveals a limitation that we should pay attention to in its use. We may need to use a more comprehensive scale or other assessment methods besides DKT2 to accurately measure the general level of diabetes knowledge when evaluating our patients.

CONCLUSION

In conclusion, healthcare providers should pay more attention to diabetes education so that patients can take necessary precautions

Table 3. Characteristics of patients' laboratory values

Parameters, (n=148)	
Creatinine, mg/dL	
Mean ± SD	1.01±1.08
Median (minimum-maximum)	0.70 (0.20-7.80)
eGFR, mL/minutes/1.73 m²	
Mean ± SD	97.8±29.5
Median (minimum-maximum)	105 (6-148)
HbA1c	
Mean ± SD	8.6±2
Median (minimum-maximum)	8.2 (5-17.6)
HbA1c, n (%)	
<7.5	45 (30.4%)
7.5-9	54 (36.5%)
≥9.5	49 (33.1%)
LDL cholesterol, mg/dL	
Mean ± SD	111.8±35.8
Median (minimum-maximum)	110 (40-219)
LDL cholesterol level, n (%)	
<100	53 (37.6)
100-129	44 (31.2)
130-159	35 (24.8)
≥160	9 (6.4)
Triglyceride, mg/dL	
Mean ± SD	175±109
Median (minimum-maximum)	139.5 (5-626)
Triglyceride level, n (%)	
<150	80 (54.1)
150-499	65 (43.9)
≥500	3 (2)

*: Multiple options were marked. SD: Standard deviation, e-GFR: Epidermal growth factor receptor, HbA1c: Hemoglobin A1c, LDL: Low-density lipoprotein.

Table 4. Patient scores from THLS-32 and DKT2

Parameters, (n=148)	
THLS-32 score	
Mean ± SD	31.4±7.95
Median (minimum-maximum)	30.7 (11-49)
Level of HL according to THLS-32	
Inadequate (0-25)	34 (23.0)
Problematic/limited (>25-33)	58 (39.2)
Adequate (>33-42)	39 (26.4)
Excellent (>42-50)	17 (11.4)
Count of correct responses to the DKT2 general test	
Mean ± SD	10.1±2.06
Median (minimum-maximum)	10 (5-14)
Correct responses to the DKT2 - general test (%)	
Mean ± SD	72.3±14.7
Median (minimum-maximum)	71.4 (35.7-100)
Correct responses to DKT2 - insulin use	
Mean ± SD	6.16±1.61
Median (minimum-maximum)	6 (2-9)
Correct responses to DKT2 - insulin use (%)	
Mean ± SD	68.4±17.9
Median (minimum-maximum)	66.6 (22.2-100)
Correct responses to total DKT2	
Mean ± SD	16.2±3.08
Median (minimum-maximum)	17 (8-23)
Correct responses to the total DKT2 (%)	
Mean ± SD	70.8±13.4
Median (minimum-maximum)	73.9 (34.7-100)

*: Multiple options were marked. THLS-32: Turkish Health Literacy Scale-32, SD: Standard deviation, HL: Health literacy, DKT2: Diabetes Knowledge Test-2.

Table 5. Correlation between DKT2 and THLS-32

	THLS-32
	r (p)
DKT2 general	0.318 (<0.001)
DKT2 insulin use	0.311 (<0.001)
DKT2 total	0.378 (<0.001)

DKT2: Diabetes Knowledge Test-2, THLS-32: Türkiye Health Literacy Scale-32.

regarding self-care or the development of complications during the treatment process. Unfortunately, providing diabetes education alone is not enough to increase patients' knowledge levels. The general HL level of the society also needs to be improved. Providing diabetes education at regular intervals, measuring patients' knowledge levels, and closely following patients with inadequate diabetes knowledge are significant approaches to disease management.

MAIN POINTS

- Education is of great importance for preventing acute and chronic complications that may develop in diabetes.
- For diabetes education, scales for the evaluation of both diabetes and health literacy of patients should be developed.
- With the help of scales to be used for diabetes, the treatment processes of patients can be performed much easier.

ETHICS

Ethics Committee Approval: This study was approved by by Hitit University Non-interventional Research Ethics Committee (approval number: 2019-14, date: 04.01.2019).

Informed Consent: All patients signed a voluntary consent form and completed the descriptive information form.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: Ü.Ş.U., D.Y., N.A., F.K.K., Design: Ü.Ş.U., D.Y., N.A., F.K.K., Data Collection and/or Processing: Ü.Ş.U., D.Y., N.A., F.K.K., Analysis and/or Interpretation: Ü.Ş.U., D.Y., N.A., F.K.K., Literature Search: Ü.Ş.U., D.Y., N.A., F.K.K., Writing: Ü.Ş.U., D.Y., N.A., F.K.K.

DISCLOSURES

Conflict of Interest: No conflict of interest was declared by the authors.

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