ORIGINAL ARTICLE

Validity and Reliability of the Arabic Translation of Diabetes Knowledge Test (DKT1)

Bawazeer Nahla M.[1], Almattawa Asim[2], Alqashami Azaam[2], Alzahem Ziad[2], Alhashem Anwar M.[3]

[1] Clinical Nutrition Program, Department of Health Sciences, College of Health and Rehabilitation Sciences, Princess Nourah bint Abdulrahman University, Riyadh 84428, Saudi Arabia
[2] College of Medicine, King Saud University, P.O. Box 18397, Riyadh 11415, Saudi Arabia
[3] Health Education Program, Department of Health Sciences, College of Health and Rehabilitation Sciences, Princess Nourah bint Abdulrahman University, Riyadh 84428, Saudi Arabia

ABSTRACT

Introduction: Diabetes Knowledge Test (DKT1) is a tool to assess patients' diabetes knowledge and lifestyle. It comprises two subscales: the DKT1-general and DKT1-insulin-use. This study aimed to translate the DKT1 into Arabic and tested its validity and reliability in the Saudi population. **Methods:** This single-centre, cross-sectional study examined diabetes-related knowledge and lifestyle of Saudi patients with diabetes who used anti-diabetic medication and/or insulin. The participants' mean scores for the two subscales of DKT1 were compared according to their type and duration of diabetes, medication use, and levels of education. Internal consistency tests and factor analysis were applied to examine the reliability and validity of the subscales, respectively. **Results:** In total, 400 individuals with diabetes (mean age 43.8±16.1 years) were enrolled. Of these, 44.2% had type 1 diabetes, and 51% were men. The Arabic version of DKT1 received internal consistency scores with coefficient alpha (95% confidence interval) values of 0.541 (0.472–0.604) and 0.741 (0.699–0.785) for the DKT1-general and DKT1-insulin-use subscales, respectively. The validity test showed that the participants with type 1 diabetes attained marginally higher score in the DKT1-general subscale and significantly higher score in the DKT1-insulin-use subscale than those with type 2 diabetes. Additionally, the scores increased with higher levels of education and longer durations of the disorder. **Conclusion:** The Arabic translation of DKT1 is an acceptable tool which can be used to measure the effectiveness of diabetes education programmes and would help to identify patient's education needs.

Keywords: Arabic translation, Diabetes Knowledge Test, Saudi Arabia

Corresponding Author:
Anwar Mohammed Alhashem, PhD
Email: AMAlHashem@pnu.edu.sa
Tel: +966 504404237

INTRODUCTION

The global incidence of diabetes mellitus has increased markedly. In Saudi Arabia, the prevalence of diabetes mellitus among adults (aged 20–79 years) reached 18.3% in 2015 (1–4). To date, no cure has been found for individuals with diabetes. However, diabetes can be appropriately managed by improving the affected individuals' lifestyle (5). Patients with diabetes are more susceptible to develop impairments in the eyes, kidneys, neurons, heart, and circulation than those without diabetes (1,6). Better glycemic control is required to prevent these devastating pathologies. To achieve this goal, individuals with diabetes must acquire basic knowledge about the disorder (1,6–8). One randomised controlled trial showed a significant improvement in the participants' knowledge about diabetes after they attended an educational programme and another showed a reduction in glycosylated haemoglobin (HbA1c) levels among participants who attended an educational programme as an intervention (9,10). A different randomised controlled study that compared Conversation Map® education and regular diabetes education, showed significant improvement in knowledge on using both tools. The findings of the study suggested that using a well-structured tool for diabetes' education would lead to better clinical outcomes (11). An Indian study in 2015 assessed the patients' knowledge, attitudes, and practices (KAP) towards hypoglycaemia after attending an educational session conducted by their physician. A remarkable change was observed in the level of the KAP parameters, which were assessed using well-structured questionnaires (12). The aforementioned studies about diabetes knowledge and educational programmes suggest that diabetes education can lead to improvement in clinical parameters (13–17). In the present study, we aimed to evaluate knowledge about the nature, complications, and management of diabetes among patients with the disorder. Additionally,

we aimed to elucidate the common sources of diabetes-related knowledge and assess the impact of this knowledge on glycemic control. To achieve these aims, a valid and reliable Diabetes Knowledge Test was needed for our population, for which an extensive search was done to find a relatively short and comprehensive diabetes knowledge questionnaire.

The Diabetes Knowledge Test (DKT1) is a popular tool aimed at assessing the patients' diabetes knowledge and lifestyle with a focus on diet, exercise, medications, and disease complications. It contains two subscales: a 14-item DKT1-general subscale and a 9-item DKT1-insulin-use subscale. DKT1's validity and reliability were tested in 1998 in the United States through a study, conducted in two populations (adults diagnosed only with type 1 and type 2 diabetes); the study's results showed that DKT1 was valid and reliable (alpha ≥0.70). In one population, the participants used various services concerning diabetes, while in the other population, the participants used diabetes health services from only health departments in their neighbourhood (18).

DKT1 is an important tool to assess the patients' self-management of the disease and to evaluate the effectiveness of diabetes education programmes. An Arabic version of this test is required to facilitate the evaluation of diabetes community programmes in Saudi Arabia. To the best of our knowledge, few studies have examined the reliability and validity of the Arabic version of the two components of the DKT1 in patients with type 1 or type 2 diabetes (19-21). Therefore, we translated the brief DKT1 into Arabic and hypothesised that the Arabic version of DKT1 will demonstrate adequate internal reliability via Cronbach's alpha analysis and sufficient validity on factor analysis.

MATERIALS AND METHODS

Design

A cross-sectional study was conducted at the diabetes outpatient clinic of [blinded information], Saudi Arabia between November 2017 and February 2018. This diabetes centre is the largest specialised centre that receives referrals from within and outside Riyadh.

Participants

The study sample was estimated to be a minimum of 384 diabetic patients from Saudi's more than 7 million total diabetic patients (22). This estimation has a confidence level of 95% and the real value is within ±5%. In total, 400 patients with diabetes were recruited. The inclusion criteria were: (i) Saudi participants with type 1 and type 2 diabetes who had diabetes for ≥3 years, (ii) aged >18 years, and (iii) consuming anti-diabetic medication and/or insulin.

Measures and procedure

The patients with gestational diabetes mellitus or pregnancy and/or who had severe physical or mental health issues were excluded from the study. The enrolled patients were interviewed one-to-one and the responses to the 23-item DKT1 were recorded. The total scores of the DKT1-general and DKT1-insulin-use subscales were 14 and 9, respectively. All interviews were conducted by the same investigator. The questionnaire comprised questions on socio-demographic characteristics including sex, age, educational level, and marital status; whether the participant was attending health promotion (diabetes education) events; type and duration of diabetes; and medication including type of ongoing anti-diabetic therapy, insulin dose and frequency, and any other ongoing medications.

A permission to translate and use DKT1 was obtained from James T. Fitzgerald, Department of Learning Health Sciences, University of Michigan. The translation process was based on the 'Brislin Backward' translation method, in which the English version of the instrument was translated into Arabic by a certified translator, and then the Arabic instrument was translated back into English by another certified translator. To check the validity of the instrument, the researchers compared the two English versions of the instrument. The final version was piloted on 10 patients and all comments from the patients were discussed by the researchers and taken into consideration.

Statistical analyses

Descriptive statistics (frequencies, percentage, mean, and standard deviation) were used to describe the categorical and quantitative variables. Student's t-tests were used for independent samples. One-way analysis of variance was used to compare the mean values of DKT1 correct% scores in the general and insulin-use subscales, between patients grouped according to the type of diabetes, medication use, duration of diabetes, and level of education. Cronbach's alpha was used to test the reliability of the items. The criterion for accepting Cronbach's alpha was a score between 0.4 and 0.7 (23). Construct validity of the Arabic DKT1 was performed using factor analysis, where the correlation matrix, Kaiser–Meyer–Olkin (KMO) measurement of sampling adequacy, and Bartlett's test of sphericity were used to assess the factorability of the 23 items. The principal component method was used to identify the factor structure. Using Eigen values explained by the two factors, the proportion of variance was obtained. The rotated factors were obtained using Varimax rotation. The significance level was set at $p < 0.05$. All analyses were conducted using the Statistical Package for Social Sciences (SPSS), version 26.0 statistical software for Windows (IBM Corp., Armonk, NY, USA).

Ethical approval

This study was approved by the ethics committee of the Medical College, King Saud University (IRB approval number 16/0603, dated 22nd of December, 2016). All

participants gave written informed consent for enrolment in the study and had the chance to continue or withdraw anytime from the study with no obligations.

RESULTS

Participants' characteristics

Table I represents the socio-demographic characteristics of the participants. Among 400 individuals with diabetes, 205 (51.3%) were men and 195 (48.7%) were women. Their mean age was 43.8 (±16.1) years. Among all participants, 44.2% had type 1 diabetes. Most participants had university education or above and were married. The mean duration of diabetes for the cohort was 15.6 (±7.44) years with the mean HbA1c level of 8.7% (±1.7%). Among all participants, 65% attended the diabetes education sessions during the follow-up at the clinic.

Table I: Distribution of Socio-demographic Characteristics of study subjects (n=400)

Characteristics	No. or Mean	SD or (%)
Mean Age	43.8	16.1
Gender		
Male	205	(51.3)
Female	195	(48.7)
Type of Diabetes		
Type 1	177	(44.2)
Type 2 required insulin	104	(26.0)
Type 2 not required insulin	119	(29.8)
Marital status		
Single	99	(25.6)
Married	261	(67.4)
Widow/divorced	27	(7.0)
Education level		
Illiterate	12	(3.1)
Primary	20	(5.2)
Intermediate/Secondary	110	(28.3)
University	193	(49.7)
Post-graduate	53	(13.7)
Income (SR)		
<4000	32	(9.2)
4000-8000	85	(24.5)
8000-10000	61	(17.6)
>10000	169	(48.7)
Family history of diabetes		
1st degree relatives	208	(53.9)
2nd degree relatives	53	(13.7)
1st& 2nd degree relatives	57	(14.8)
None	68	(17.6)
Duration of Diabetes (yrs.)		
≤ 15 years	215	(53.9)
>15 years	184	(46.0)
Diabetes complications		
Vasculopathy	26	(8.7)
Retinopathy	51	(12.8)
Nephropathy	10	(2.5)
Foot ulcer	13	(3.3)
None	316	(79.4)
Source of information about diabetes		
Physician	319	(82.2)
Nutritionist	119	(30.7)
Diabetes Educator	138	(35.6)
Nurse	20	(5.2)
Family & friends	49	(12.6)
Visual media	53	(13.7)
Printed media	59	(15.2)
Social media	54	(13.9)
Internet	77	(19.8)
Others	11	(2.8)
Have received diabetes education		
Yes	256	(65.1)
No	137	(34.9)
Have visited nutrition clinic		
Yes	305	(78.8)
No	82	(21.2)
Mean BMI (kg/m2)	29.2	5.78
Mean HbA1c	8.7	1.7

Abbreviations: SD: Standard deviation; HbA1c: glycosylated hemoglobin

Reliability of DKT1

The data given in Table II indicate that the Arabic version of DKT1 received moderate and high internal consistency scores with coefficient alpha (95% confidence interval) values of 0.541 (0.472–0.604) and 0.741 (0.699–0.785) for the 14-item DKT1-general test and 9-item DKT1-insulin-use subscale, respectively. These values were within the recommended range of Cronbach's alpha tests. In the DKT1-general test, the percentage of correct answers was lower for item numbers 4, 8, and 3, i.e., 'which of the following is a free food' (31.5%), 'which should not be used to treat low blood glucose' (35.0%), and 'which of the following is highest in fat' (36.8%), respectively, while in the DKT1-insulin-use subscale, item number 17, i.e., 'If you have taken intermediate-acting insulin, you are most likely to have an insulin reaction in:' had the lowest percentage of correct answers (34.9%).

Validity of DKT1

Factor analysis was used to determine construct validity of DKT1 instrument. The 23 items of the instrument showed highly significant statistical correlation. Multicollinearity was checked using the determinant of the correlation matrix; we decided not to eliminate any of the 23 items as all these items correlated well but none of the correlations were large. The analysis provided a KMO measure of 0.899 which indicates that the Bartlett's test of sphericity was statistically significant (χ^2=3269.32, P<0.0001). This implies that the correlation matrix is not an identity matrix. From the analysis of the factor extraction, the percent of variance attributable to each factor, and the cumulative variance of the factors, was observed such that the first factor accounted for 26.15% of the variance and the second factor accounted for 9.25% of the variance. The scree plot is a graph of the Eigen values against all the factors, where the curve starts to flatten after two factors as shown in Fig 1.

The loadings of the 23 items of the DKT1 scale on the two extracted factors were given in Table III. The factor loadings indicate that the two factors (DKT1-general test and DKT1-insulin-use test) contributed to each of their respective items.

Further, we compared the mean% correct scores for the DKT1-general and DKT1-insulin-use subscales of DKT1 in relation to the participants' level of education, duration of diabetes, type of diabetes, and treatment. There was a statistically significant difference in the mean% correct scores of both subscales in relation to the participants' level of education, such that subjects with higher levels of education (University and post graduate) responded correctly more often than participants with lower levels of education did (p<0.0001 & p=0.005).

Table II: Test reliability of Arabic translation of Diabetes Knowledge Test

	Percentage of correct answers	Alpha, if item deleted	Alpha (95% confidence interval)
General test (1-14)	*n* = 400		
Item 1	65.3	.518	
Item 2	76.8	.513	
Item 3	36.8	.536	
Item 4	31.5	.522	
Item 5	48.8	.537	
Item 6	66.0	.527	
Item 7	58.0	.532	.541
Item 8	35.0	.526	(.472–.604)
Item 9	63.5	.524	
Item 10	85.8	.527	
Item 11	88.8	.530	
Item 12	72.0	.516	
Item 13	84.8	.499	
Item 14	87.3	.502	
Insulin use (15-23)	*n* = 281		
Item 15	41.8	.725	
Item 16	54.0	.719	
Item 17	34.9	.744	
Item 18	43.0	.736	.742
Item 19	64.5	.714	
Item 20	64.0	.703	(.699–.785)
Item 21	66.0	.706	
Item 22	54.3	.712	
Item 23	61.0	.711	

The mean% correct scores of the DKT1-general test were significantly higher among subjects who had diabetes for >15 years (p=0.022); however, no significant difference was observed for the DKT1-insulin-use test in relation to the duration of diabetes. The mean% correct scores of the DKT1-insulin-use test were significantly higher in participants with type 1 diabetes than in participants type 2 diabetes who used insulin (p<0.0001). There was no significant difference in the DKT1-general test scores in relation to the type of diabetes and treatment (Table IV).

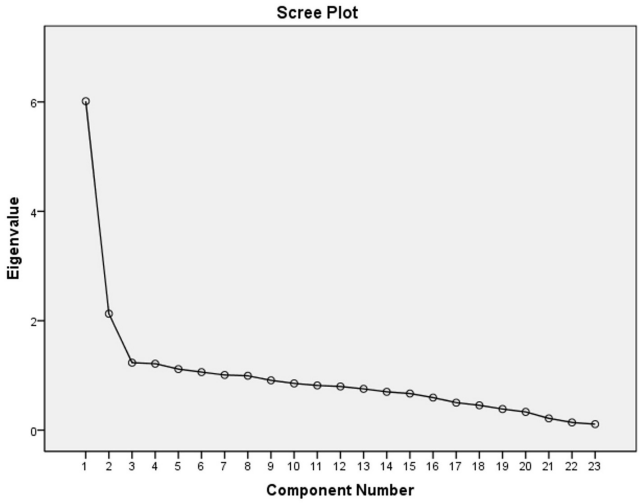

Figure 1: The scree plot is a graph of the Eigen values against all the factors, where the curve starts to flatten after two factors.

DISCUSSION

The present study evaluated the Arabic translation of the most widely used self-reported test that assesses the knowledge about diabetes care and management. The DKT1 has been translated to more than five languages, including Greek, Norwegian, Hindi, Malay, Spanish, and Arabic (21). Although previous studies have evaluated the validity and reliability of the Arabic translation of DKT1, these studies were limited by small sample sizes. The present study had a larger sample size than other studies conducted in Saudi Arabia. Additionally, our study included participants with both the types (type 1, type 2) of diabetes and evaluated the reliability and validity of both the subscales (DKT1-general and DKT1-insulin-use) of the DKT1. The original DKT1 was translated from English to Arabic using the forward-backward method to generate an acceptable version that was as close as possible to the original English version and could be utilised by the health care practitioners. Our results showed that the Arabic translated version of DKT1 was acceptable and could be used in the Saudi population.

Further, the Arabic translated DKT1 received a lower internal consistency score (0.541) than the original English version DKT1 (18), and the Malaysian (21) and Arabic versions (19) for the 14-item DKT1-general test, while its scores were similar (0.741) to those of the original English version (18) and outweighed the Turkish study results (24) for the 9-item insulin-use subscale. The discrepancy in the results between different DKT1 language versions could be related to the cultural differences and populations been studied (25). However, the present Arabic translation of DKT1 followed a systematic translation process and underwent pilot testing before its application. Furthermore, the lowest percentages of correct answers in the 14-item DKT1-general test were in the items related to diet management. Similar results have been reported in a study conducted in the Khashm Al Aan primary specialised clinic in Riyadh (19) as well as in another study of two clinics at a tertiary care hospital in Al Ain city, United Arab Emirates (26). The similarity could be because of the focus of Saudi health authorities and health care teams on educating patients about the medication and importance of regular blood glucose monitoring, rather than on the importance of nutrition, diet management, and regularity of physical activity and exercises (20). Focusing on the latter could help diabetes educators identify patients who need more help in self-management of diet and exercise.

The validity of the translated test was also examined.

Table III: Factor loadings for construct validity of the Arabic translation of Diabetes Knowledge Test (DKT1)

Items of DKT1	Loadings	
	Factor 1 (General test)	**Factor 2 (Insulin-use-test)**
DKT1-general test:		
Q1 The diabetes diet is…		0.348
Q2 Which of the following is highest in carbohydrate?		0.415
Q3 Which of the following is highest in fat?		0.229
Q4. Which of the following is a "free food"?		0.353
Q5. A1C is a measure of your average blood glucose level for the past…		0.304
Q6. Which is the best method for home glucose testing?		0.316
Q7. What effect does unsweetened fruit juice have on blood glucose?		0.295
Q8. Which should not be used to treat a low blood glucose?		0.299
Q9. For a person in good control, what effect does exercise have on blood glucose?		0.326
Q10. What effect will an infection most likely have on blood glucose?		0.293
Q11. The best way to take care of your feet is to…		0.328
Q12. Eating foods lower in fat decreases your risk for…		0.479
Q13. Numbness and tingling may be symptoms of…		0.629
Q14. Which of the following is usually not associated with diabetes?		0.588
DKT1-insulin-use test:		
Q15. Signs of ketoacidosis (DKA) include…	0.683	
Q16. If you are sick with the flu, you should…	0.797	
Q17. If you have taken rapid-acting insulin, you are most likely to…	0.575	
Q18. You realize just before lunch that you forgot to take your insulin at breakfast…	0.683	
Q19. If you are beginning to have a low blood glucose reaction, you should…	0.902	
Q20. A low blood glucose reaction may be caused by…	0.909	
Q21. If you take your morning insulin but skip breakfast, your blood glucose…	0.921	
Q22. High blood glucose may be caused by…	0.803	
Q23. A low blood glucose reaction may be caused by…	0.873	

Table IV: Comparison of mean values of tests scores in relation to educational level, duration, type, and treatment of study subjects

Study variables	General test			Insulin test		
	Mean (±SD) % correct scores	**F-value/ t-value**	**p-value**	**Mean (±SD) % correct scores**	**F-value/ t-value**	**p-value**
Level of education						
Illiterate	60.7 ± 13.4	6.039	<0.0001	54.3 ± 26.3	3.809	0.005
Primary	59.6 ± 14.7			67.5 ± 23.7		
Intermediate/secondary	59.2 ± 15.8			70.5 ± 23.7		
University	66.0 ± 17.3			78.6 ± 22.2		
Post-graduate	71.0 ± 14.5			75.6 ± 24.1		
Duration of diabetes						
≤ 15 years	62.6 ± 17.0	-2.300	0.022	72.0 ± 25.1	-1.901	0.058
>15 years	66.4 ± 16.0			77.2 ± 21.2		
Type of diabetes & treatment						
Type 1	65.5 ± 18.0			82.3 ± 18.8		
Type 2 using insulin	62.7 ± 16.6	0.976	0.378	61.8 ± 24.6	7.872	<0.0001
Type 2 not using insulin	63.9 ± 14.3			------		

Abbreviations: SD: Standard deviation

As expected, the test scores were higher among the participants with type 1 diabetes, higher levels of education, and longer duration of diabetes. The findings of our validity testing are consistent with those of the original questionnaire, which showed that the participants with type 1 diabetes obtained higher scores than those with type 2 diabetes (18), marginally in the DKT1-general and significantly in the DKT1-insulin-use subscales. In addition, the scores increased with the increasing level of education and longer duration of diabetes. In contrast, a similar cross-sectional study conducted at King Abdulaziz Specialist Hospital, Saudi Arabia, found that patients who had type 2 diabetes for more than 10 years scored less than those who had the disease for 5–10 years (27).

The present study has few limitations. Although this study involved 400 participants for the assessment of diabetes knowledge, the participants were recruited from a single diabetes centre in the capital of Saudi Arabia, where the participants were generally aware about health, understood basic health and nutrition terminology, and were frequently followed-up by the health care providers in the diabetes centre.

CONCLUSION

The findings of our study suggest that the Arabic translated version of DKT1 is acceptable and can be used in the Saudi population with diabetes to assess their level of knowledge about the nature, complications, and management of diabetes mellitus. In the future, it is recommended to apply DKT1-general and DKT1-insulin-use in rural communities to comprehend possible differences in DKT1 items.

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