



The 14-item Michigan Diabetes Knowledge Test: translation and validation study of the Malaysian version

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Introduction

Diabetes mellitus is one of the mounting health problems in the current era; it is continuously increasing its prevalence and is gaining high levels of morbidity and mortality. The International Diabetes Federation has predicted that there will be 380 million individuals with diabetes in 2025 compared with an estimated 240 million in 2007, with a higher disease burden in low- and middle-income nations.¹ In Malaysia, the Third National Health and Morbidity Survey showed that the prevalence of type 2 diabetes (T2DM) for adults aged 30 years old and above now stands at a staggering 14.9%, with the highest prevalence among those of Indian ethnicity at 19.9%.² Poor glycaemic control of diabetes is a major cause of complications, and good glycaemic control is associated with fewer complications.³ The morbidity and mortality resulting from micro- and macrovascular complications of T2DM place a considerable financial burden on individual patients and on society.⁴

Diabetes self-management education is the cornerstone of care for all patients with diabetes and is necessary for the improvement of patient outcomes; it is defined as the ongoing process of facilitating the knowledge, skill and ability necessary for diabetes self-care.⁵ Evaluation of diabetes knowledge has been an important composition in the overall assessment of patients with diabetes for many years.⁶ Measurement of knowledge as

ABSTRACT

The aims of this study were to translate the Michigan Diabetes Knowledge Test (MDKT) into the Malaysian language, and to examine the psychometric properties of the Malaysian version.

A standard translation procedure was used to create the Malaysian version of the MDKT from the original English version. A convenience sample of 307 outpatients with type 2 diabetes was identified between May and October 2009. All data were collected from the Penang General Hospital, Penang, Malaysia. Instruments consisted of the Malaysian version of the MDKT and a socio-demographic questionnaire. Medical records were reviewed for haemoglobin A_{1c} (HbA_{1c}) levels and other clinical data. Reliability was tested for internal consistency using Cronbach's alpha coefficient.

Employing the recommended scoring method, the mean±SD of MDKT scores was 7.88±3.01. Good internal consistency was found (Cronbach's alpha = 0.702); the test-retest reliability value was 0.894 (p<0.001). For known group validity, a significant relationship between MDKT categories and HbA_{1c} categories (chi-square = 21.626; p≥0.001) was found.

The findings of this validation study indicate that the Malaysian version of the MDKT is a reliable and valid measure of diabetes knowledge which can now be used in clinical and research practice. Copyright © 2010 John Wiley & Sons.

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KEY WORDS

diabetes knowledge; validation; Michigan test; translation

outcomes in diabetes patients' education programmes has been carried out using knowledge tests in the last decade.⁷ However, few valid and reliable instruments and easy to use knowledge scales are available. The Michigan Diabetes Research and Training Center developed a series of valid and reliable knowledge tests that could be used in research and practice for knowledge assessment.⁶ The Michigan Diabetes Knowledge Test (MDKT) has been used in several studies to assess diabetes knowledge.^{8–10} Researchers conclude that metabolic control of diabetes can be affected by the patient's knowledge.^{11,12} For proper patient care, a planned educational programme is

needed and this should first start with a valid evaluation of educational need and assessment of the degree of patients' knowledge. From an extensive literature review, MDKT appears to be valid, reliable and easy to apply for the assessment of knowledge in patients with diabetes in Malaysia; the test is considered appropriate for testing diabetes knowledge in adults with reliability scores of 0.7 and 0.71 from two different Michigan populations.^{6,9} Because of the wide use of the scale as a diabetes knowledge measurement tool, we were interested in translating the MDKT and documenting some of its psychometric properties in Malaysian people with T2DM.

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Materials and methods

This study received approval from the Ministry of Health MREC (Medical Research Ethics Committee), and from Penang General Hospital. All subjects provided written consent before participation.

Participants and setting

A cross-sectional study design and methodology were used to elaborate the study data. This study was conducted in the Diabetes Clinic of the Penang General Hospital, Penang, Malaysia. Penang General Hospital is the largest public and tertiary hospital in Penang state. It provides health care, emergency treatment for all illnesses and accidents, and primary and advanced medical health care. A convenience sample of 307 T2DM outpatients was identified between May and October 2009. To be included in the study, patients had to (1) have been diagnosed with T2DM at least one year before, (2) use antidiabetic medications, (3) be over 30 years of age, and (4) be able to communicate in the Malaysian language. Patients who had severe health problems or cognitive impairment and could not complete interviews were excluded. Face-to-face interviews included administration of the translated 14-item MDKT and collection of socio-demographic data. A total of 274 patients were eligible and included in the analysis (approximately 89.2%). On the same day as the interviews, medical records were reviewed for HbA_{1c} levels, number of hypoglycaemic medications, whether or not the patient used insulin, and the presence of diabetic complications such as neuropathy, retinopathy, nephropathy or cardiovascular disease. In addition, 65 patients from the sample were randomly selected and agreed for a one-month reliability test-retest analysis. Only 59 patients completed the test-retest after one month. All 274 face-to-face and 59 re-interviews were performed by the investigator, who is a pharmacist.

Instrument translation

The instrument consisted of three parts. Part one collected socio-demographic data, part two was the 14-item MDKT, and part three was the laboratory data to be collected from the patients' records. The three parts of

the data collection sheet were translated together according to the international guidelines,^{13,14} as follows.

- Forward translation of the original questionnaire was undertaken by translation from English to the Malay language to produce a version that was semantically and conceptually as close as possible to the original questionnaire. Translation was done by two qualified, independent linguistic translators – both native speakers of Malaysian and proficient in English. Each translator produced a forward translation of the original questionnaire into the target language without any mutual consultation. One of the researchers, who is Malaysian, reviewed the two primary versions and compared them with the original.
- Reverse translation from Malaysian to English was carried out by another translator, after repeated discussion between the translators and Malaysian researchers. Inconsistencies were resolved in a consensus meeting and a final version, ready for testing, was generated.
- The translated questionnaire was distributed to 20 Malaysian patients who completed the questionnaire and commented on the questions. These individuals were not included in the study. The patients' comments were discussed by the researchers. Subsequently, six postgraduate pharmacy students who are experts in the field judged the face and content validity of the questionnaire.
- The final version of the Malaysian questionnaire was completed and made available for the reliability and validity study. The questionnaire takes about 10–12 minutes to complete.

Statistical analysis

Descriptive statistics were used to describe patients' demographic and disease characteristics and their diabetes knowledge scores. Percentages and frequencies were used for the categorical variables, while means and standard deviations were calculated for the continuous variables. The characteristics of the whole sample and of the knowledge groups were presented. The chi-square test was employed for categorical variables and analysis of variance (ANOVA) tests were used to evaluate the differences between the groups.

To test reliability, the internal consistency was assessed using Cronbach's alpha, and Spearman's rank correlation was used to assess test-retest reliability. The criterion for accepting Cronbach's alpha is a score above 0.7.¹⁵ Known group validity was assessed through the association of HbA_{1c} levels ($\geq 7\%$ and $< 7\%$) and MDKT categories using chi-square tests. Known group validity was also assessed by using Mann-Whitney U test, assuming that patients with poor diabetes control also report lower levels of knowledge. All analyses were performed using SPSS version 15.0 (SPSS Inc, Chicago, IL). The significance level was set at $p < 0.05$.

Results

Clinical and demographic data

The final analysis included 274 patients with diabetes, with 59 patients completing the test-retest portion. The characteristics of the total and knowledge groups are shown in Table 1. Of the 274 patients with diabetes, 103 (37.59%), 110 (40.14%) and 61 (22.26%) were in the low, acceptable and good knowledge groups, respectively. Significant differences were found in educational levels, HbA_{1c} levels, and MDKT scores among the three groups ($p < 0.05$). No significant differences ($p \geq 0.05$) were found among the three groups in terms of age, sex, BMI, race, educational level, monthly income, employment, medication number and duration of diabetes.

Reliability

Cronbach's alpha test of internal consistency was 0.702 for the 14 items in MDKT, which is around 0.7 and within the recommended result.¹⁵ For male and female patients, Cronbach's alpha was 0.670 and 0.727, respectively. Its item to total correlation coefficient ranged from 0.140–0.429 (Table 2). The test-retest reliability of the 14-item MDKT indicates excellent reliability and stability of the instrument with Spearman's rank correlation coefficient of 0.894 ($p < 0.001$).

Known groups validity

The chi-square test shows a significant relationship between MDKT categories and HbA_{1c} categories (chi-square = 21.626; $p \geq 0.001$). Around



Table 1. Demographic characteristics of patients with diabetes

Characteristics	Total sample n=274	Level of knowledge		
		Low (<7); n=103	Acceptable (7–10); n=110	Good (≥11); n=61
Age (yrs), mean±SD	60.42±9.36	60.17±9.11	59.97±9.5	61.3±9.22
Sex, n (%)				
Male	135 (49.3)	51 (49.5)	60 (54.5)	24 (39.3)
Female	139 (50.7)	52 (50.5)	50 (45.5)	37 (60.7)
Body mass index, mean±SD	26.55±5.21	26.76±5.48	26.52±5.32	26.28±4.56
Race, n (%)				
Malay	99 (36.1)	41 (39.8)	34 (30.9)	24 (39.3)
Chinese	90 (32.8)	33 (32.0)	39 (35.5)	18 (29.5)
Indian	83 (30.3)	29 (28.2)	36 (32.7)	18 (29.5)
Others	2 (0.7)	0	1 (0.9)	1 (1.6)
Educational level, n (%)				
No formal education	30 (10.9)	17 (16.5)	9 (8.2)	4 (6.6)
Primary	68 (24.8)	25 (24.3)	27 (24.5)	16 (26.2)
Secondary	160 (58.4)	57 (55.3)	67 (60.9)	36 (59.0)
University	16 (5.8)	4 (3.9)	7 (6.4)	5 (8.2)
Employment status, n (%)				
Not employed	90 (32.8)	35 (34.0)	31 (28.2)	24 (39.3)
Private	65 (23.7)	27 (26.2)	31 (28.2)	7 (11.5)
Government	33 (12.0)	9 (8.7)	14 (12.7)	10 (16.4)
Retired	86 (31.4)	32 (31.1)	34 (30.9)	20 (32.8)
Monthly income, n (%)				
Less than RM 2000	220 (80.3)	90 (87.4)	84 (76.4)	46 (75.4)
RM 2000–4000	46 (16.8)	9 (8.7)	24 (21.8)	13 (21.3)
More than RM 4000	8 (2.9)	4 (3.9)	2 (1.8)	2 (3.3)
Diabetic duration (yrs), mean±SD	9.75±7.63	10.16±7.61	8.94±7.25	10.54±8.29
No. of medications, mean±SD	4.39±1.71	4.38±1.78	4.43±1.66	4.32±1.69
HbA _{1c} (%), mean±SD	7.79±1.43	8.1±1.36	7.89±1.57	7.09±1.02
14-item MDKT, mean±SD	7.88±3.01	4.71±1.28	8.59±1.18	11.95±0.95

75.7% of patients with low knowledge were in the poor glycaemic control group, while 60.7% of those in the high knowledge group were in the good glycaemic control group. Table 3 shows the distribution of the three knowledge groups according to poor and good HbA_{1c} level. As hypothesised, patients who reported poor control of their diabetes (HbA_{1c} >7%) also reported lower levels of knowledge about diabetes. A Mann-Whitney U test was conducted to compare the MDKT scores for those with poor and those with good diabetes control. There was a significant difference in

scores for the good control group (mean±SD 9.01±3.03) and for the poor control group (mean±SD 7.2±2.79; $z [272] = 4.777$; $p < 0.001$).

Discussion

This was a translation and validation study of the most widely used self-reported instrument for measuring diabetes knowledge. It is not simply a case of translating a questionnaire into another language.^{13,14} Instead, a more extensive approach is required in which cultural and language equivalence, as well as psychometric properties, are checked. The 14-item

MDKT is a relatively good and straightforward questionnaire; therefore, cultural adaptation and language equivalence were performed and subsequently found to be maximal. The translation of the original English MDKT was in compliance with the standard procedure detailed in translation guidelines.¹⁶

The original MDKT is well-developed and validated, making it relatively simple and practical to use in a variety of population and clinical settings.⁶ It consists of 14 items which are suitable for assessing general diabetes knowledge, used by several



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Table 2. Reliability test of the 14-item MDKT

MDKT question number	Mean±SD	Corrected item: total correlation	Cronbach's alpha if item deleted
Question 1	0.61±0.48	0.337	0.683
Question 2	0.52±0.5	0.314	0.686
Question 3	0.54±0.49	0.369	0.679
Question 4	0.36±0.48	0.336	0.683
Question 5	0.43±0.49	0.330	0.684
Question 6	0.63±0.48	0.140	0.707
Question 7	0.55±0.49	0.300	0.688
Question 8	0.31±0.46	0.429	0.672
Question 9	0.69±0.46	0.211	0.698
Question 10	0.51±0.5	0.378	0.677
Question 11	0.75±0.43	0.238	0.695
Question 12	0.66±0.47	0.333	0.683
Question 13	0.64±0.48	0.330	0.684
Question 14	0.69±0.46	0.357	0.680

Cronbach's alpha was 0.702 for the total scale with significant intra-class correlation coefficient ($p < 0.001$).

Key points

- MDKT proved to be a reliable tool for assessment of diabetes patients' knowledge
- MDKT is easy to administer in practical and academic use

Malaysian diabetic patients showed that the 14-item MDKT had good internal consistency and good test-retest reliability (0.894). The sample of diabetic patients in this study was smaller than the sample used in the previous validation study.⁶ The known group comparison analysis indicated that the Malaysian version of the MDKT is a valid instrument for measuring diabetes knowledge because the instrument was able to differentiate between patients who were clinically different. A significant association was found between the 14-item MDKT scores and diabetic control represented by HbA_{1c}.

The Malaysian version of the MDKT proved to be acceptable to patients; it is a simple questionnaire that can be administered by a trained nurse in face-to-face interviews to overcome non-response by those who cannot read, although the original questionnaire is a self-administered instrument. In summary, the findings from this validation study indicate that the Malaysian version of the MDKT is a reliable and valid measure of diabetes knowledge which can now be used in clinical practice because it shows acceptable test-retest reliability and validity.

Table 3. Relationship between knowledge categories and glycaemic control groups*

Glycaemic group	Level of knowledge			Total	P-value
	Low n (%)	Acceptable n (%)	Good n (%)		
Good control HbA _{1c} ≤7%	25 (24.3)	41 (37.3)	37 (60.7)	103	≤0.001
Poor control HbA _{1c} >7%	78 (75.7)	69 (62.7)	24 (39.3)	171	≤0.001
Total	103 (100)	110 (100)	61 (100)	274	

* Number (%) of patients; chi-square = 20.261, $p \leq 0.001$.

studies to assess knowledge, but according to our review of the literature it has been previously translated into only two languages – Mandarin and Arabic.^{17,18} This study translated the MDKT from the original English to a Malaysian version by following the proposed guidelines.¹³ Simple translation of a scale from one language to another may be prone to mistakes in relation to the essence of the original version if no attention is given to the language differences and the cultural and lifestyle context. The translated form of the MDKT used simple, easily understood language that even poorly educated patients can understand. After the MDKT had been translated and cross-culturally adapted, the reliability and validity of

the newly translated version were proved to have been maintained. The reliability of the MDKT was confirmed using measures of internal consistency and test-retest, and validity was examined through known group validity.

The main objective of this paper was to report the reliability and validity of the translated version of the MDKT in a sample of diabetic patients. This study was the first to systematically translate and validate the 14-item MDKT into the Malaysian language. The original 14-item MDKT was tested by Fitzgerald *et al.*⁶ on two population samples of diabetic patients, and it was found that the scale was reliable with good predictive validity. Our study among

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Conflict of interest statement

There are no conflicts of interest.

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