Short Report: Education and Psychological Aspects

Modification and validation of the Revised Diabetes Knowledge Scale

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Abstract

Objectives   To develop a simplified true/false response format of the Revised Diabetes Knowledge Scale and assess scaling assumptions, reliability and validity of the binary response format (the Simplified Diabetes Knowledge Scale) and compare with a multiple-choice version.

Methods   Ninety-nine respondents attending an outpatient clinic completed the multiple-choice version of the Revised Diabetes Knowledge Scale and the simplified version of the Revised Diabetes Knowledge Scale. The response patterns and psychometric properties of both questionnaires were assessed in order to test the construct validity of the simplified version.

Results   The mean age of the respondents was 57 years (range 21–83 years) and 64% were men. Respondents attained an average score of 65% on the Simplified Diabetes Knowledge Scale, compared with 62% on the Revised Diabetes Knowledge Scale. Overall, the Simplified Diabetes Knowledge Scale appeared to be somewhat easier to complete compared with the Revised Diabetes Knowledge Scale, as indicated by the number of missing responses.

Conclusions   The Simplified Diabetes Knowledge Scale provides researchers with a brief and simple diabetes knowledge questionnaire with favourable psychometric properties. The scale may require further updating to include other items relevant to diabetes education. This simplified version will now undergo translation and validation for use among minority ethnic groups resident in the UK.

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Keywords   diabetes knowledge, minority ethnic groups, psychometric properties, questionnaire

Introduction

The prevalence of Type 2 diabetes continues to increase and the risk of developing this condition is at least five times higher in South Asians living in the UK compared with the White indigenous population [1–3]. Supporting the self-management of diabetes in South Asian communities is often compromised because of cultural and communication barriers, particularly in groups where low levels of literacy are common [4–9]. In particular, there is strong evidence to suggest that knowledge about diabetes (a prerequisite for effective self-management) amongst minority ethnic groups is poor [4–9]. This evidence has mainly been from qualitative work, which has played an important role in gaining understanding of the health beliefs of some minority ethnic groups. Until now, there have been no formal tools developed to assess diabetes knowledge in South Asian communities and our research aims to begin to address that deficit. The development of a new tool could aid the assessment of culturally applicable diabetes education programmes, thus enhancing care, which could, in the long term, help reduce morbidity in these groups [10].

In our previous research, we have demonstrated the acceptability of both self-complete and audio methods of collecting data in South Asian people with diabetes, especially those from Pakistani/Mirpuri and Bangladeshi/Sylheti backgrounds [11]. In this research, we developed culturally appropriate written and audio versions of the Revised Diabetes Knowledge Scale. The Revised Diabetes Knowledge Scale is an adapted version of the Michigan Diabetes Knowledge Scale [12], which was revised because of idioms specific to the USA that were not appropriate for a UK population [11]. Our previous research has demonstrated the applicability of the Revised Diabetes

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Knowledge Scale in both South Asian and White Caucasian individuals attending our diabetes clinic. The Revised Diabetes Knowledge Scale consists of 17 multiple-choice questions (core items) to assess a patient's diabetes-related knowledge, including items on diet, blood glucose control, exercise, medication taking and complications, with an additional three items for patients taking insulin. Each question contains four responses to a statement for the respondent to choose from. However, the use of the Revised Diabetes Knowledge Scale was not without its difficulties. This was particularly the situation for those individuals whose main language was only spoken and was not written, which is the case for a large proportion of diabetes patients in our clinical area. We found the implementation of the audio version of the Revised Diabetes Knowledge Scale to be problematic because respondents had to rely on their memory, as four answers to each question had to be remembered. Therefore, a follow-up study was planned in order to develop a new simplified version of the Revised Diabetes Knowledge Scale [11]. The aim of this study was to validate this simplified version in a cohort of diabetes patients attending an outpatient clinic and to investigate whether it maintained the content and structure of the original multiple-choice version.

Subjects and methods

Prior to testing, a Simplified Diabetes Knowledge Scale was developed where the multiple-choice responses of the Revised Diabetes Knowledge Scale were replaced by a 'true or false' format. The Simplified Diabetes Knowledge Scale was developed in consultation with the Diabetes Specialist Nurse Team and the Asian Link Workers based in the Diabetes Centre at Heartlands Hospital, the Warwick Diabetes Care Service Users group, and the authors of the original Michigan Diabetes Knowledge Scale [12]. With the exception of item 17 ('You realize just before lunch that you forgot to take your insulin before breakfast. What should you do now?'), all items on the Revised Diabetes Knowledge Scale had an equivalent item on the new scale (the Simplified Diabetes Knowledge Scale). This item could not be answered with a true/false format and so was excluded. Overall scores for both scales (omitting the non-core items) were calculated as the proportion of correct responses.

A convenience sample of patients attending the Birmingham Heartlands Hospital diabetes outpatient clinic were selected to participate in the study. Individuals were consecutively recruited until 100 participants had agreed and given consent to participate in the study. The inclusion criteria were: (i) patients with diabetes attending the diabetes clinic; (ii) age ≥ 18 years; and (iii) ability to read and write English. There was no selection by type of diabetes.

Statistical analysis

Our analysis assumes that the Revised Diabetes Knowledge Scale and the Simplified Diabetes Knowledge Scale exhibit only one underlying latent trait, and this was assessed using a modified parallel analysis as proposed by Drasgow and Lissak [13]. A 'one-parameter' Rasch model was used to examine response patterns. This model assumes that the probability of a person answering an item correctly depends on the person's underlying knowledge and item difficulty. The item 'difficulty' estimate, resulting from the model, quantifies the difficulty level of individual test items (the smaller the value, the easier the item). The probability of responding to an item correctly was also reported from the Rasch model. Model fit was assessed by performing a parametric bootstrap test based on Pearson's χ^2-test statistic.

Internal reliability of the two scales was evaluated using Cronbach's alpha, a value between 0 and 1, which is a measure of how well items within a scale correlate with the sum of the remaining items. Item–total correlations were calculated to assess the usefulness of individual items, where a value of 0.4 is seen as an item providing sufficient information to the total score [14]. Corrected item–total correlations (to identify items that are not consistent with the rest of the instrument) were calculated by deleting the item from the hypothesized construct total and then correlating the item with that total (without the item). Items should ideally correlate reasonably well with the total score. Items with noticeably low item–total correlations (< 0.2) are usually candidates for closer inspection and/or removal from the scale [14].

Item discrimination is the ability of an item to differentiate respondents on the basis of their diabetes knowledge and was calculated by the point–biserial coefficient; values exceeding 0.4 are classified as good and > 0.3 as fair [15].

Results

Ninety-nine of the 100 individuals who participated completed both knowledge questionnaires (64 men and 35 women). As shown in Table 1, the mean age of all subjects was 56.8 years (range 21–83 years) and the majority (n = 85) recorded their ethnicity as White British/White Irish or Other White Background. Fifteen recorded their ethnicity as South Asian. Thirty-seven respondents reported being treated with insulin for their diabetes.

Forty-seven participants completed the Revised Diabetes Knowledge Scale first, followed by the Simplified Diabetes Knowledge Scale, and 42 participants completed the Simplified Diabetes Knowledge Scale first, followed by the Revised Diabetes Knowledge Scale. The order of test completion was not recorded for 11 of the study participants. There was no observable difference between Revised Diabetes Knowledge Scale scores in those respondents answering the Revised Diabetes Knowledge Scale first (median 10) and those who answered the Simplified Diabetes Knowledge Scale first (median 11; P = 0.25). However, there was a marginal difference in Simplified Diabetes Knowledge Scale scores between those who responded to the Simplified Diabetes Knowledge Scale second (median 12) and those who responded to the Simplified Diabetes Knowledge Scale first (median 11; P = 0.045). Of the 17 core items on the

Table 1 Participant characteristics (*n* = 99)

Characteristic	*n*
Age (years)	
Mean	56.8
Range	21–83
Sex	
Male	64
Female	35
Ethnicity	
White British	79
White Irish	4
Other White background	1
Asian Indian	1
Asian Pakistani	11
Asian Bangladeshi	1
Other Asian background	2
Duration of diabetes	
< 10 years	63
10–15 years	14
> 15 years	18
Not known	4

Revised Diabetes Knowledge Scale, with an interquartile range of 9 to 13 (Table 2).

Excluding the insulin-treated-only items, respondents had a median of three missing items using the Revised Diabetes Knowledge Scale (range 0–7), whilst, for the Simplified Diabetes Knowledge Scale, respondents had a median of two missing items (range 0–10). Items 12 and 20 in the original Revised Diabetes Knowledge Scale had the most missing responses (both 12/99), whilst, for the corresponding items on the Simplified Diabetes Knowledge Scale, the number of individuals with missing responses was one and six.

Item 9 on the Revised Diabetes Knowledge Scale required the respondent to correctly identify three factors (without specifying the number of correct responses) that help to reduce high blood pressure from a list of four possible answers. Only 33 of the cohort identified all the factors, 15 respondents identified two factors correctly and 36 respondents identified only one factor correctly. The corresponding item on the Simplified Diabetes Knowledge Scale significantly reduced the complexity of this question (there was only one correct answer) and 89% of the sample answered the item correctly. Conversely, item 20 (on the importance of clinic appointments) appeared easier to complete on the Revised Diabetes Knowledge Scale, with 68% of respondents correctly identifying the answer, compared with only 24% on the Simplified Diabetes Knowledge Scale.

Simplified Diabetes Knowledge Scale, a median of 12 items were answered correctly by the study sample (interquartile range 10–14), and a median of 11 items were correctly answered on the

Table 2 Revised Diabetes Knowledge Scale (RDKS) and Simplified Diabetes Knowledge Scale (SDKS) item analysis

RDKS	SDKS		Percentage correct		Discrimination†		Item difficulty (rash analysis)	Probability of getting item correct
Item	Item no. RDKS/SDKS	Item	RDKS	SDKS	RDKS	SDKS	SDKS	SDKS
Diabetes diet	1/1		80	96	0.30	0.12	−3.80	0.98
Glycosylated haemoglobin	2/2		33	34	0.52	0.45	0.83	0.31
Carbohydrates	3/3		66	74	0.39	0.42	−1.27	0.77
Fat	4/4		36	63	0.42	0.45	−0.64	0.65
Testing blood glucose	5/5		69	46	0.42	0.61	0.21	0.45
Unsweetened fruit juice	6/6		38	34	0.36	0.36	0.83	0.31
Testing low blood glucose	7/7		34	55	0.24	0.33	−0.24	0.56
Raised cholesterol	8/8		54	79	0.36	0.21	−1.61	0.82
High blood pressure	9/9		33	89	0.18	0.21	−2.53	0.92
Exercise	10/10		87	77	0.21	0.39	−1.47	0.80
Infection	11/11		70	64	0.58	0.52	−0.70	0.66
Feet	12/12		76	58	0.21	0.45	−0.39	0.59
Foods low in fat	13/13		88	95	0.24	0.15	−3.53	0.97
Numbness and tingling	14/14		69	57	0.55	0.52	−0.34	0.58
Associated problems	15/15		78	72	0.27	0.24	−1.15	0.75
Flu	16/16		76	64	0.30	0.48	−0.70	0.66
Forget to take insulin*	17/NA		69	NA	—	—	—	—
Blood glucose levels*	18/17		82	77	—	—	—	—
Breakfast and blood glucose*	19/18		33	56	—	—	—	—
Clinic appointments	20/19		68	24	0.61	0.18	1.42	0.21

*Only completed by insulin-treated patients.
† Item discrimination is the ability of an item to differentiate respondents on the basis of their diabetes knowledge. The higher the value in magnitude, the higher the item discriminates. Values exceeding 0.4 are deemed good discriminators.
NA, not applicable.

The internal reliability of the Simplified Diabetes Knowledge Scale, as measured by Cronbach's alpha, was 0.71 and was 0.61 for the Revised Diabetes Knowledge Scale. Cronbach's alpha excluding each item ranged from 0.57 to 0.62 for the Simplified Diabetes Knowledge Scale and from 0.69 to 0.71 for the Revised Diabetes Knowledge Scale. Item correlations with the total knowledge test score ranged from 0.26 to 0.58 on the Simplified Diabetes Knowledge Scale and between 0.23 and 0.45 on the Revised Diabetes Knowledge Scale.

Item 9 on the Revised Diabetes Knowledge Scale ('Which of the following can help reduce high blood pressure?') was the only question with a very low item–total correlation. Corrected item–total correlations (i.e. with the item deleted) were > 0.2 for all items on the Revised Diabetes Knowledge Scale, except for items 7, 8, 12, 15 and 16. Whilst, for the Simplified Diabetes Knowledge Scale S, all corrected item–total correlations were > 0.2, except for items 7, 8 and 20.

Overall, the participants obtained an average score (using core items only) of 62% on the Revised Diabetes Knowledge Scale (interquartile range 53–76%) and 65% (interquartile range 56–78%) on the Simplified Diabetes Knowledge Scale, a difference of 3% (95% CI 0.2–5.8%).

Rasch analysis of the Simplified Diabetes Knowledge Scale indicated that items 1, 13, 19 and 9 were the easiest items to answer (the probability of getting the item correct exceeding 0.9), whilst items 5, 2, 6, 20 were the most difficult to answer (the probability of getting the item correct less than 0.5), which agrees closely with the percentage answering correctly (Table 2). Fitting a two-parameter model, allowing individual items to have different discriminative levels, did not offer any improvement over the single parameter model. Goodness-of-fit, as determined by 200 bootstraps of the Pearson's χ^2-test statistic, indicated no concerns for lack of fit (P = 0.37).

Discussion

We developed a simplified version of the Revised Diabetes Knowledge Scale to reduce the complexity of the multiple-choice version of the questionnaire. A limitation of this study to be kept in mind, however, is the relatively small sample size. A further limitation is the absence of specific items on the scale which question patients' knowledge of the annual review or what is monitored therein. Therefore the scale may require further updating to include other items relevant to diabetes education. The simplified version (the Simplified Diabetes Knowledge Scale) will be subsequently translated and assessed in larger samples, both as a paper-and-pencil self-complete and as an audio version amongst minority ethnic groups in the UK, where literacy levels are often low [11]. The respondents found the simplified version marginally easier to complete, with more correct responses compared with the Revised Diabetes Knowledge Scale. One noticeable difference was on item 9, which required the respondent on the Revised Diabetes Knowledge Scale to identify three factors (from a list of four) that could help reduce high blood pressure. A further item that appeared to be easier to

correctly answer on the Revised Diabetes Knowledge Scale was item 20, which may have been because the options were less extreme compared with the true/false version. The small but statistically significant difference in average scores between the Revised Diabetes Knowledge Scale and the Simplified Diabetes Knowledge Scale suggests that the two instruments cannot be used interchangeably. However, this was not the intention, but rather the development of a simplified tool which could be used in a range of ways in different patient populations.

The simplified version of the Diabetes Knowledge Scale (the Simplifed Diabetes Knowledge Scale) provides health researchers with a brief and simple instrument to assess the individual's knowledge of diabetes. The simplified version reduces the complexity of multiple-choice responses that exist in the revised version of the Diabetes Knowledge Scale. With knowledge and literacy problematic in the South Asian community in the UK, a simplified questionnaire tailored to meet the needs of this community will contribute to research and the evaluation of methods designed to improve patient outcomes in this group. Further studies are planned in order to develop an audio version of the questionnaire for use in low-literacy populations.

Competing interests

Nothing to declare.

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