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ORIGINAL PAPER

Translation and psychometric evaluation of the Diabetes Education Questionnaire (DATE-Q) from English to Marathi – assessing reliability, validity, and cross-cultural equivalence

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ABSTRACT

Introduction and aim. The DiAbeTes Education Questionnaire (DATE-Q) is a self-administered tool created to evaluate disease-related knowledge and knowledge of five core components of rehabilitation: exercise, diet, psychological well-being, self-management and complications. The aim was to translate and adapt the DATE-Q into Marathi language and to evaluate the validity and reliability among diabetes and prediabetic patients.

Material and methods. The study was carried out following standard stepwise Beaton and COSMIN guidelines to complete the translation and psychometric validation of the questionnaire. The pre-final version was evaluated in 30 individuals with diabetes or prediabetes. Test-retest reliability and internal consistency were assessed among 200 individuals with type 2 diabetes using Cronbach's alpha and intraclass correlation coefficients respectively.

Results. The original and translated versions did not conceptually differ from each other. DATE-Q has ten elements that were culturally adjusted. Based on suggestions from the expert group and the results of the pilot tests, cross-cultural modifications were made. The value of 0.935 for Cronbach's alpha shows a very high level of internal consistency. For single and average measures, the intraclass correlation coefficient is 0.985 and 0.993 resp. which indicates an excellent level of reliability.

Conclusion. The DiAbeTes Education Questionnaire is a reliable and valid tool for evaluating knowledge among Marathi-speaking patients.

Keywords. cross cultural evaluation, diabetes mellitus, health education, psychometric evaluation, reliability, validity

Introduction

Type 2 diabetes (DM2) is a chronic condition requiring ongoing self-management to prevent serious complications such as cardiovascular disease (CVD), nephropathy, and retinopathy.[1–4] In India, DM2 is a growing public health problem, with cases projected to rise from 74.2 million in 2021 to 124.9 million by 2045.[5] Cardiovascular complications remain a leading cause of mortality in DM2 patients, who are 2–4 times more likely to experience major events than those without diabetes.[6]

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Effective self-management, supported by diabetes education, is essential for maintaining blood glucose levels, preventing complications, and promoting behavioral changes.[7] However, education is limited, particularly in socioeconomically disadvantaged populations.[8] Standardized tools are essential to evaluate diabetes knowledge and guiding education programs.[9] Although existing instruments like the Diabetes Knowledge Questionnaire (DKQ-24) and the Diabetes Knowledge Assessment Scale (DKN-A) assess aspects of diabetes management, they may not address all necessary domains comprehensively.[10,11]

The Diabetes Education Questionnaire (DATE-Q), validated in low-resource settings like Brazil, provides a holistic approach by assessing five domains: self-management, long-term complications, physical activity, healthy eating and psychosocial well-being.[9,12] Translating and validating this tool into Marathi, the official language of Maharashtra, will allow its use among a population of more than 120 million, ensuring culturally and linguistically appropriate evaluation of diabetes knowledge and education outcomes. This research aims to improve diabetes education and self-management for Marathi speaking people, ultimately improving health interventions and outcomes.

Aim

The aim was to translate and culturally adapt the DATE-Q into Marathi and evaluate its reliability, validity, and cross-cultural equivalence for use among Marathi speaking populations.

Material and methods

Design and procedures

The cross-sectional and experimental study was conducted by following standard stepwise Beaton and COSMIN guidelines for the translation and psychometric validation of the questionnaire.[13,14] Permission was obtained from the original author and the Institutional Ethics Committee (EC/NEW/INST/2019/377/183).

Step 1: Forward translation. The translation process began with forward translation. Two bilingual translators, Translator 1 (T1) and Translator 2 (T2), both fluent in English and Marathi, were selected. Marathi was their native language. T1, an assistant professor in the physiotherapy department, had knowledge of DM2 and the concept measured by the questionnaire. T2, without medical background, was unfamiliar with the construct of the questionnaire. Both translators independently submitted their translated versions to the study coordinator, along with written explanations for their translation choices.

Step 2: Synthesis of forward translations. The next step involved synthesizing the translations from T1 and T2 under the guidance of the study coordinator. The two versions were combined to create a single translated version.

Step 3: Back translation followed, with two bilingual translators (BT1 and BT2) translated the combined T1 and T2 version back into English. Both back translators were native English speakers, without prior medical training, and were blinded to the original DATE-Q questionnaire and its purpose. The two translated versions were compared with the original questionnaire to assess the precision and comprehension of the terms.

Step 4: Expert committee review. An expert committee consisting of a diabetologist, a methodologist, health professionals, language experts, and translators reviewed the translated questionnaire. They provided feedback on the necessary changes to ensure cultural and linguistic appropriateness.

Step 5: Pilot test. A pilot study was conducted with 30 patients attending the cardiovascular and respiratory physiotherapy department. The patients completed the pre-final version of the questionnaire and their feedback was collected. This step was designed to assess the relevance, clarity, and completeness of the questionnaire's statements, response options, and instructions.

To identify potential problems, the interviewer recorded the full responses to each statement and calculated the number of items marked as unclear or misunderstood by theparticipants. The clarity of each statement was assessed using a Likert scale from 1 ("I do not understand anything") to 4 ("I understand completely"). The questionnaire, consisting of 20 items, was rated on this scale. The pre-final version was revised based on participants' feedback to address any issues identified.

Following this step, the tool was administered to a sample of 200 individuals to assess the reliability of the questionnaire. The scores for each domain were calculated based on the number of items and the minimum and maximum possible scores for each domain.

To assess test-retest reliability, the translated questionnaire was administered to patients with DM2. Participants completed the questionnaire, and their total scores were recorded. After 7 to 21 days, the questionnaire was re-administered to the same participants, and their scores were recalculated.[9] Differences between the initial and subsequent scores were analyzed to determine the consistency and reliability of the results.

Participants and setting

For the psychometric evaluation, following the recommendation of Hair and Anderson ,which suggests that each item of the questionnaire should have at least 10 participants, a sample size of 200 was determined. Participants who were native Marathi speakers and diagnosed with DM2 (HbA1C level of 6.5% and above) or prediabetes (HbA1C level between 5.7% and 6.5%)[16] were included in the study.[15,16]

The study was carried out in a tertiary care teaching hospital, using purpose-sampling to select participants. Informed consent was obtained from all individuals.

DATE-Q questionnaire

The DATE-Q was originally developed in English by Ghisi et al. to serve as a concise and accessible tool for use in clinical and research settings.[12] The DATE-Q consists of 20 true/false/I don't know items written in plain language, making it suitable for self-administration. The elements are divided into five domains: self-management, long-term complications, activeness, healthy eating, and psychosocial well-being, which guided the selection of the statements included in the tool. Each correct answer earns 1 point, with a maximum score of 20 points, evenly distributed across the five domains, allowing for a maximum of 4 points per domain.

- Domain 1: Self-management: items 2, 12, 16, 18
- Domain 2: Long-term complications: items 1, 3, 6, 11
- Domain 3: Being active: items 4, 8, 13, 17
- Domain 4: Healthy eating: items 5, 9, 14, 20
- Domain 5: Psychological Well-being: Items 7, 10, 15, 19

Correct answers for interpretation:

- True: Statements 1, 4, 6, 7, 8, 10, 11, 12, 14, 18, 19, 20
- False: Statements 2, 3, 5, 9, 13, 15, 16, 17

Data analysis

Data were entered into Microsoft Excel and analyzed using the Social Sciences Statistical Package (SPSS) version 28 (SPSS Inc., Chicago, IL, USA). Internal consistency was assessed by calculating Cronbach's alpha values greater than 0.70 were considered acceptable, indicating a strong correlation between items and with the total score. 17 The reliability was evaluated using the intra-class correlation coefficient (ICC) by administering the same test to participants at two different times to assess the consistency of the scores.

For Cronbach's Alpha, 0.70-0.79 is acceptable, 0.80–0.89 is good and ≥0.90 is excellent. ICC values greater than 0.75 indicate good reliability and values above 0.90 indicate excellent reliability.

Results

Translation and cultural adaptation

Table 1 presents the original words or phrases that were translated and culturally adapted by an expert committee, based on feedback from the prefinal version tested with individuals diagnosed with DM2. Adjustments made were intended to improve the clarity and understanding of the questionnaire items.

The prefinal version was tested for cultural relevance with 30 individuals diagnosed with DM2. Most of the participants rated the items as 2 or 3, indicating some confusion. As a result, certain words and phrases were retranslated and culturally adapted in consultation with the expert committee. Based on these findings (Table 1), five elements were modified to improve clarity and cultural relevance. For example, in item nine, "canned soup" was replaced with "processed food," as canned soup is not typically consumed in Maharashtrian cuisine. Furthermore, sentences in items 2, 5, 8, 10, 15, and 18 were rephrased to improve coherence and clarity. For items 5, 7, 9, 13, alternative words for "discomfort" were used to ensure greater understanding among patients.

Table 1. Cultural adaptation made after the pre-final version of the questionnaire

Q.NO	Words or phrases from the original version	Words according to translators and expert committee and their rating on Likert scale	Final changes according to the survey made during the pre-final version and their rating on Likert scale
02	"after eating a meal"	जेवल्यानंतर	जेवणानंतर
04	"bands"	बँड	पट्टा
05	"large" "Prevent" "And"	मोठ्या मदत आणि	जास्त प्रतबिंध व
07	"And" "Prevent you from becoming overwhelmed"	आणि दबून जाण्यापासून रोखू शकते.	व असण्यामुळे भारावून टाकण्यापासून प्रतबिंध करू शकते
08	"manage"	व्यवस्थापन करण्यात	व्यवस्थापनेची
09	"canned soup" "choices"	कॅन केलेला नविडी असतात.	तयार कविा प्रक्रयिा केलेले अन्न नविड असते
10	"to help"	मदत करण्याचा	मदतीचा
13	"Sores" "ulcers" "should check"	फोड तपासा	जखम तपासले पाहजिे
15	"does not affect"	परणिाम होत नाही.	परणिाम करत नाही
16	"carbohydrate" "acting"	कार्बोहायड्रेट अभनिय	कर्बोदके परणिामकारक
17	"your" "zone"	तुमचे क्षेत्रामध्ये	तुमची पातळीवर
18	"Oral" "If you take"	तोडी घेतल्यास	तोडाद्वारे घेत असाल
20	"foods from plants"	वनस्पतीपासून अन्न	वनस्पतीजन्य पदार्थ

Psychometric evaluation

The validity of the content, an essential aspect of the adaptation and validation process, was carefully considered, especially when adapting the instruments for use in a foreign country and language. For this study, the validity of the content was established through validation by a panel of experts, including a diabetologist, a methodologist, forward and backward translators, health professionals and language experts.

Of the 200 respondents, 69.5% were male (139) and 30.5% were female (61), with an average age of 61.68 years (SD=14.23). The mean level of HbA1c among the participants was 7.11 (SD=0.91). Table 2 presents a summary of the responses to all 20 items, showing the mean

scores (mean), variability (standard deviation), and the number of respondents (n). Each question (Q1 to Q20 post-test values) was analyzed, with the mean providing the central tendency of the responses, and the standard deviation indicating the degree of variation around the mean. In particular, complete agreement (mean=1, SD=0) was observed for the items Q8post, Q9post, Q10post and Q20post, indicating a high level of consensus among participants for these items.

Table 2. Mean and standard deviation for each question (n=200)

Q		Mean	Std. deviation
1	मधुमेहासह जगताना, गुंतागुंत टाळण्यासाठी तुमचे रक्तदाब आणि कोलेस्टेरॉल व्यवस्थापित करणे महत्वाचे आहे.	0.85	0.36
2	जेवणानंतर दोन तासांनी, तुमच्या रक्तातील साखर १० मिली मोल/लिटर पेक्षा जास्त असावी.	0.14	0.35
3	तुमच्या A1C रक्त चाचणीचे परिणाम गेल्या वर्षभरातील तुमच्या रक्तातील साखरेची सरासरी पातळी दर्शवतात.	0.24	0.43
4	प्रतिकार प्रशिक्षण (पट्टा कवि वजन वापरणे) तुमचे स्नायू मजबूत करण्यास आणि रक्तातील साखर कमी करण्यात मदत करू शकते.	0.58	0.49
5	न्याहारी वगळणे आणि रात्रीचे जेवण जास्त प्रमाणात खाल्ल्याने रक्तातील साखरेचे प्रमाण जास्त व कमी होण्यास प्रतिबंध होईल.	0.85	0.36
6	तुमचा A1C कमी (७ % पेक्षा कमी) ठेवल्याने मधुमेहाची गुंतागुंत टाळण्यास मदत होईल.	0.165	0.37
7	तुमच्या भावनांची जाणीव ठेवणे आणि मदत व समर्थन मागणे तुम्हाला मधुमेह असण्यामुळे भारावून टाकण्यापासून प्रतिबंध करू शकते	0.955	0.21
8	तुमच्या रक्तातील साखरेचे व्यवस्थापनेची मदत करण्यासाठी व्यायाम हा एक चांगला मार्ग आहे.	1	0.0
9	तयार कवि प्रक्रिया केलेले अन्न हे दररोजसाठी आरोग्यदायी अन्न नविड असते.	1	0.0
10	तुमच्या कुटुंबाकडून आणि मित्रांकडून पाठबिा मळिवणे हा तुम्हाला तणावाचा सामना करण्यासाठी मदतीचा एक चांगला मार्ग आहे.	1	0.0
11	जर तुमचा मधुमेह व्यवस्थति नियंत्रति केला गेला नाही, तर तुमच्या रक्तवाहनि्या आणि निसा खराब होऊ शकतात.	0.955	0.21
12	तुम्हाला सर्दी कवि फ्लू असताना तुमच्या रक्तातील साखर नेहमीपेक्षा जास्त कवि कमी असू शकते.	0.875	0.33
13	व्यायामापूर्वी तुम्ही तुमच्या पायांना फोड, जखम कवि अल्सरसाठी तपासले पाहजि.	0.335	0.47
14	तंतुमय पदार्थ खाल्ल्याने तुमची रक्तातील साखर, एल. डी.एल (खराब) कोलेस्टेरॉल आणि रक्तदाब कमी करून मधुमेह नियंत्रति होण्यास मदत होते	0.485	0.5
15	तुम्ही तुमचा मधुमेह कसा व्यवस्थापति करता यावर नैराश्य परणिाम करत नाही	0.5	0.5
16	जर तुमची रक्तातील साखर खूप कमी असेल तर तुम्ही जलद-परणिामकारक कर्बोदके म्हणून चॉकलेट खावे.	0.59	0.49
17	जेव्हा तुमची हृदय गती लक्षणयति पातळीवर असते आणि तुम्हाला धाप लागते तेव्हा तुम्ही योग्य स्तरावर व्यायाम करत आहात	0.25	0.43
18	जर तुम्ही इन्सुलनि कवि तोंडाद्वारे काही मधुमेहाची औषधे घेत असाल (ग्लायब्युराइडसारख्या गोळ्या) तर तुमच्या रक्तातील साखर कमी होण्याची शक्यता जास्त असते.	0.98	0.14
19	टाइप २ मधुमेहामध्ये खराब झोप कवि स्लीप एपनयिा सामान्य आहे आणि त्यामुळे तुमचे आरोग्य बधिडू शकते.	0.39	0.49
20	मधुमेहासाठी आरोग्यदायी आहारामध्ये अधकि वनस्पतीजन्य पदार्थ खाणे समावषि्ट आहे. उदाहरणार्थ: फळे, भाज्या, संपूर्ण धान्य आणि शेंगा	1	0
Total		0.67	0.31

Cronbach's Alpha was used to assess the internal consistency of the questionnaire in its various domains. The overall scale, consisting of 20 items, demonstrated a high level of internal consistency with a Cronbach Alpha of 0.935, which slightly increased to 0.945 when the items were standardized. For individual domains, the Self-management domain (4 items) had a Cronbach Alpha of 0.975 (standardized=0.979), the long-term complications domain (4 items) showed an Alpha of 0.957 (standardized=0.966), the Being active domain (4 items) had 0.954 (standardized=0.967), the Healthy eating domain (4 items) achieved 0.975 (standardized=0.982), and the Psychosocial wellbeing domain (4 items) recorded 0.945 (standardized=0.964). These results indicate excellent internal consistency across all domains of the questionnaire, reflecting its reliability as a measurement tool.

ICC analysis provided additional reliability measures (Table 3). For single measures, the ICC was 0.985, with a 95% confidence interval of 0.980 to 0.989, and an F test value of 133.505 (df1=199, df2=200, p<0.001), indicating excellent reliability. For the average measures, the ICC was even higher at 0.993, with a confidence interval of 0.990 to 0.994 and the same F test results, reinforcing the high reliability of the average measures.

Table 3. ICC measures of the questionnaire

	ICC						
	Intraclass correlation	95% confidence interval		F Test with true value 0			
		Lower bound	Upper bound	Value	df1	df2	p
Single measures	0.985	0.980	0.989	133.505	199	200	<0.001
Average measures	0.993	0.990	0.994	133.505	199	200	<0.001

Discussion

The successful translation and validation of the Marathi version of the DATE-Q confirmed its cross-cultural equivalence to the original English version. This process adhered to established guidelines, ensuring that the translation preserved the original intent while taking into account linguistic and cultural nuances.[13,14] By maintaining high internal consistency and test-retest reliability, the Marathi version of the DATE-Q demonstrated its ability to assess the same constructs as the original tool, although it was applied in a different linguistic and cultural context. The careful attention to linguistic and cultural variations during the translation process was critical to ensuring that the Marathi version was both relevant and suitable for Marathi-speaking individuals. This cross-cultural equivalence is essential to confirm that the questionnaire is valid and applicable in different cultural settings, which is particularly important in a global health context where diabetes management needs to be tailored to local populations.

The study involved 200 participants, with a demographic breakdown of 69.5% male and 30.5% fe-

male respondents, and an average age of 61.68 years (SD=14.23). The variability in the age distribution was reflected in the HbA1c levels, with an average of 7.11 (SD=0.91). These demographic characteristics are representative of the general population involved in diabetes education initiatives, allowing for a meaningful interpretation of the findings.[18] Average HbA1c levels suggested that participants were generally managing their diabetes at a controlled level, consistent with findings from other studies on diabetes management.[19] The gender balance and the range of age provided context for understanding the applicability of the questionnaire, making the findings relevant to the target community.

The internal consistency of the Marathi DATE-Q was rigorously evaluated using Cronbach's alpha, which measures the degree to which items within each domain and across the overall scale reliably measure the same underlying construct. The general Cronbach alpha for the 20-item scale was 0.935, with a standardized value of 0.945. These values are significantly above the commonly accepted threshold of 0.70, indicating excellent internal consistency.[17] Each domain of the questionnaire-self-management, long-term complications, being active, healthy eating and psychosocial well-being-showed high Cronbach's alpha values, ranging from 0.954 to 0.979. This suggests that the translation and cultural adaptation process preserved the internal consistency of the original English version, confirming the robustness and reliability in assessing various aspects of diabetes education.

The reliability of the test-retest, assessed using the ICC, provided further evidence of the stability of the Marathi DATE-Q over time. The ICC of 0.993 for the mean measures indicated excellent stability, with minimal measurement error between the first and second administration of the questionnaire. This result aligns with similar studies, such as the Brazilian validation study by Felix et al., which reported good test-retest reliability (ICC=0.5) and acceptable internal consistency (Cronbach's alpha=0.6) for the Brazilian Portuguese version of DATE-Q.[9] This reinforces the reliability of Marathi DATE-Q as a tool for measuring diabetes-related knowledge related to diabetes in different linguistic and cultural contexts.

Responses to the Marathi DATE-Q also showed various patterns of agreement, as indicated by mean and standard deviation values for each item, highlighting its capacity to capture the diverse aspects of diabetes education and management. For example, the means ranged from 0.14 to 1.0, while the standard deviations ranged from 0.0 to 0.5, indicating a broad spectrum of responses between participants. This variability reflects differences in knowledge and understanding of diabetes education within the population, which is essential to identify gaps and tailoring interventions accordingly. A study by Heise et al. found that structured diabetes self-management education (DSME) programs are effective in increasing personal awareness of diabetes, consistent with the goals of DATE-Q in assessing diabetes-related knowledge.[20] Structured DSME programs positively impact individuals' understanding of their condition and improve self-management behaviors, underscoring the importance of reliable tools like Marathi DATE-Q in supporting such programs.

The validated Marathi DATE-Q has proven to be an important tool for both clinical practice and research. It allows healthcare professionals to assess the effectiveness of diabetes education programs in Marathi speaking populations and identify areas for improvement. This aligns with the findings of Gordon et al., who emphasized the need for valid and culturally sensitive tools to evaluate the outcomes of diabetes education outcomes.[21] The Marathi DATE-Q provides a reliable and culturally appropriate method to evaluate diabetes knowledge, ultimately supporting targeted interventions that can improve patient education and diabetes care in Marathi speaking communities. Future research should address certain limitations, such as incorporating a more balanced sample and comparing the Marathi DATE-Q with other validated tools. This would further establish the generalizability and provide insight into how it performs relative to other established measures in diabetes education. Additionally, expanding the use of Marathi DATE-Q across different regions and populations could help to further validate its cross-cultural applicability.

Study limitations

This study had several limitations that could impact the generalizability of the findings. First, the sample had a higher proportion of male participants (69.5%) compared to female participants (30.5%), which could potentially introduce gender bias. As a result, the findings may not fully capture the experiences and perceptions of the female participants, limiting the applicability of the Marathi DATE-Q to both genders equally.

Furthermore, the study did not include a comparison between Marathi DATE-Q and other established diabetes education measures, which would have improved the construct validity. Comparing the Marathi DATE-Q with other validated tools for assessing diabetes knowledge would provide a clearer understanding of how it performs relative to other existing instruments, strengthening its validation.

Another limitation is that Marathi is spoken in various regional dialects and the language can differ significantly between different areas. As the study focused on a specific demographic, there may be contextual variations in how the questionnaire is interpreted in the broader Marathi-speaking population. This could affect the generalizability of the findings in all regions where Marathi is spoken.

Finally, the baseline educational qualifications and socioeconomic criteria of the participants were not considered during recruitment. These factors could influence the understanding and responses to the questionnaire, potentially introducing variability that was not considered in this study. Future research should consider these factors to better understand how education and socioeconomic status impact responses to diabetes education assessments.

Conclusion

The translation and cross-cultural adaptation of DATE-Q into Marathi were successfully completed in accordance with established guidelines and procedures. To ensure the cultural relevance and comprehensibility for the target population, ten items were culturally adapted. The translated version of the DATE-Q demonstrated excellent validity, reliability, and high internal consistency when applied to patients with diabetes and prediabetes participating in cardiac rehabilitation. The Marathi version of the DATE-Q has proven to be a reliable and valid tool for evaluating knowledge related to type 2 diabetes in this demographic.

Future research should focus on comparing Marathi DATE-Q with other diabetes education tools. This comparison would help validate its constructs more rigorously and improve its psychometric properties. Such research would be valuable for monitoring the effectiveness of ongoing diabetes education initiatives and assessing their impact on patient self-management.

Declarations

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Authors' contributions

Conceptualization, V.J. and S.K.; Methodology, S.K.; Software, G.G. and V.J.; Validation, G.G., V.J. and S.K.; Formal Analysis, P.P.; Investigation, S.K. and V.J.; Resources, D.K. and M.K.; Data Curation, S.K.; Writing – Original Draft Preparation, S.K., V.J. and P.P.; Writing – Review & Editing, S.K., D.K. and M.K.; Visualization, V.J.; Supervision, G.G.; Project Administration, V.J. and S.K.; Funding Acquisition, V.J.

Conflicts of interest

The authors declare no conflict of interest.

Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval

All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of the MIT's MAEER Physiotherapy College, Talegaon Dabhade (approval number: EC/NEW/INST/2019/377/183).

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