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Original Article

The diabetes management self-efficacy scale: Translation and psychometric evaluation of the Iranian version

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ABSTRACT

Background & Aim: Perceived self-efficacy could lead to self-management behaviors among diabetic patients and the Diabetes Management Self-efficacy Scale (DMSES) assesses the extent to which diabetic patients are confident that they can manage diabetes. However, the Iranian version of DMSES was not available. The objective of this study was the translation and psychometric evaluation of the Iranian version of the DMSES .

Methods & Materials: Using a standard forward-backward translation procedure, the original English language version of the questionnaire was translated into Persian (Iranian language). Then, a convenient sample of diabetic patients, who referred to a diabetes outpatient clinic and were aged 15 to 81 years, completed the questionnaire. Validity was evaluated by content validity ratio and then using factor analysis. To test the reliability, internal consistency was assessed by Cronbach's alpha.

Results: In total, 332 diabetic patients entered into the study. The mean age of respondents was 1.8 ± 12.3 years. Employing the recommended method of scoring (ranging from 1 to 5), the mean DMSES score was 2.24 ± 0.54. Reliability analysis showed satisfactory results (Cronbach's alpha = 0.92). Exploratory factor analysis showed 20 items of the scale could converge to 5 factors with rotation. Confirmatory factor analysis supported modified model of DMSES through which one item (item 20) moved from blood glucose factor to medical control factor. Criterion-related validity showed that the DMSES was a significant predictor of the diabetes self-management ($R = 0.61$; $P < 0.001$) .

Conclusion: The study findings showed that the Iranian version of the DMSES has a good structural characteristic and is a valid and reliable instrument that can be used for measuring diabetes management self-efficacy.

Introduction

Diabetes mellitus is one of the most common metabolic disorders that cause long-term complications (1). It has been estimated that the prevalence among adults aged 20-70 years will rise from 285 million in 2010 to 438 million by the year 2030 (2). Thus, health care expenditure for diabetes control will be a heavy financial burden for societies and health care systems in the future (3). Diabetes self-management (DSM) activities such as complying with prescribed medication regimen, strict calorie-controlled diet, doing regular exercise, checking blood glucose, and caring for feet is as important as pharmacological treatments for diabetic patients (4). Behavior changes in diabetic patients through self-management education is an essential part of the treatment approach of patients living with type 2 diabetes

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mellitus (5, 6). Many diabetic patients consider these self-care activities to be difficult (1).

Self-efficacy is a person's assessment of his or her ability to perform healthy behavior in deferent situations (7). Several studies have demonstrated that perceived self-efficacy could lead to self-management behaviors among diabetic patients (8). Furthermore, systematic review investigations indicate that self-efficacy could positively influence self-management behaviors of diabetic patients (9-10).

It has been shown that development of specific tools for self-efficacy assessment could facilitate self-management measurement among diabetic patients. In 1999 Bijl et al. developed a self-efficacy scale for measuring self-management behavior in diabetic patients with the title of "Diabetes Management Self-efficacy Scale". This scale assesses the extent to which diabetic patients are confident that they can manage their blood sugar, diet, and level of exercise (11). Until now, this scale has been adapted for use in several countries, including Australia, China, and Turkey (1, 12, 13).

The results of construct validity of the original scale and non-English language versions for different countries were almost different. In the original and Chinese version 4 factors were generated, but 3 factors were generated in the Turkish version (1, 11, 13). Furthermore, the 4 factors identified in the original scale and Chinese version were different.

Therefore, given the high prevalence of diabetes, importance of self-management, effects of self-efficacy on self-management, and cultural differences between countries, it is necessary to confirm whether this scale can be used in Iranian diabetic patients and to see whether the Persian version of this scale is an unbiased version of the English version. It was hoped this might contribute to the existing literature and give both researchers and health professionals the opportunity to use the questionnaire in their potential research and practice in the future. Once a valid and reliable scale is ready for use, it can be used to measure outcomes in an intervention study. This will permit further testing of Bandura's Theory of self-efficacy that states that assisting people to increase their self-efficacy will result in effective management of diabetes.

Therefore, this study's aim was the translation and psychometric evaluation of the Iranian version of the Diabetes Management Self-Efficacy Scale (DMSES).

Methods

The original version of the Diabetes Management Self-Efficacy Scale (DMSES) is a self-administered scale containing 20 items (11). It assesses the extent to which respondents are confident they can manage their blood sugar, diet, and level of exercise. Responses are rated on a 5 point scale ranging from ‘‘can't do at all’’ to ‘‘certain can do’’ (1, 5). In this scale, higher scores indicate higher self-efficacy in performing DSM activities. The standard "forward–backward" procedure was applied to translate the questionnaire from English into Persian (14). At first, the researcher translated the original scale into Persian. Then, a health education specialist, who was fluent in both Persian and English, back-translated the questions into English. In addition, 2 faculty members and the principle researcher evaluated the meaning equivalency between the original version and the back-translated version of the questionnaire. There was no significant difference between the two versions. The translated instrument was reviewed by a group of Iranian instrument development experts, including 8 health education specialists and nurses. Panel members were asked to review each item and assess the appropriateness of translated items in terms of being understood by Iranian diabetic people. Then, content validity ratio (CVR) was applied to assess the extent of the experts' agreement on the questions. Content validity was assessed by each panel member through a 3-reponse categorized Likert-type scale as "necessary", "useful but not necessary", and "unnecessary". If an item was rated as "unnecessary", the expert who rated was asked to provide his or her suggestions for its modification or elimination. In this study, a CVR score of .80 or higher indicates good content validity (15). Finally, the final version of the questionnaire without any change was confirmed by panelists.

Item analysis was used to decide which items should be omitted (16, 17). To do this, the translated questionnaire was administered to a sample of 40 diabetic patients referred to a diabetic outpatient clinic. In the present study, the range of mean score for each item was from 1.43 to 2.72 and standard deviation was from 0.64 to 1.57.

Pearson's correlation coefficient (r) was examined to assess the correlation between each item's mean score and total item mean score; r of equal or above 0.3 was considered satisfactory.

To test construct validity, exploratory and confirmatory factor analyses were performed. Exploratory factor analysis (EFA) was used to determine the number of latent factors (initially) or the pattern of relationships between the common factors and the indicators. Confirmatory Factor Analysis (CFA) was used to test and modify the model that emerged from the EFA and specify the number of factors and the pattern of indicator-factor loadings (17, 18). With this regard, several alternative models were tested.

(a) A 1-factor model was used to test whether DMSES could measure one overall factor, rather than separate factors.

(b) An uncorrelated factor model was applied to test whether separate factors would be independent. This model would suggest that measured factors are independent constructs.

(c) A correlated factor model was used to test whether separate factors of DMSES would be related to each other. This model would suggest the possibility of a hierarchical model.

(d) A hierarchical model was applied to test the idea that a second-order factor could account for relations between individual factors. Support for this model would suggest that all factors are related to a higher-order factor. Retention of such a model would suggest that summing the total of the entire scale is appropriate and represents a meaningful and interpretable score (20).

The EFA was done with SPSS for Windows (version 13; SPSS Inc., Chicago, IL, USA) and CFA was completed with LISREL (Linear Structural Relationships version 8.8).

In EFA, factors were extracted using principal-component factor analysis with a varimax rotation. Eigenvalues greater than 1 and factor loading cut-off of 0.4 were used in order to obtain the best fitting structure and the correct number of factors.

Model fit criteria in CFA were chi-square (χ^2), goodness-of-fit index (GFI), the adjusted goodness-of-fit index (AGFI), and the root-mean-square error of approximation (RMSEA). Therefore, the model would be fit if GFI values were greater than 0.9, AGFI greater than 0.8, and RMSEA less than 0.06. In the present study, Bentler-Bonett non-normed fit index (NNFI) was used as comparative fit index; therefore, values of 0.90 or greater were considered acceptable. The Akaike information criterion (AIC) was selected as measure of model parsimony. There were no generally accepted cut-off values for the AIC. While comparing models, those with lower AIC values were considered more parsimonious and better models (20).

To modify the model, T value was used to eliminate parameters, and modification index (MI) was applied to include additional parameters. Internal consistency reliability of the total scale and each factor was assessed through Cronbach's alpha.

In this study for observing research ethics, the aim of the study was verbally explained to the potential participants that had the inclusion criteria, and all of the persons were free for participation in the research. Furthermore, the participants were assured that all information would be kept secret and anonymous.

Results

In this study, 332 Iranian diabetic patients were recruited through convenience sampling procedure. The age of participants ranged from 15 to 81 years with a mean age of 51.8 ± 12.3. Most of the participants were female (72.3%). Of the 330 responders, 78.3% (n = 260) were educated up to primary/secondary level of education, 15.7% (n = 52) were graduated from high school, and 5.4% (n = 18) had obtained college degrees. The mean duration of diabetes disease of the studied patients was 7.9 ± 6.9 years and ranged from 1 to 40 years.

Of all the participants, 21.7% (n = 72) used insulin, 66.2% (n = 220) were treated by oral drugs, 3.6% (n = 12) had nutritional diet, and 8.4% (n = 28) used mixed treatment. Most of the patients in this study had family history of diabetes (63.3%).

Before construct validity assessment, reliability of the scale was assessed through Cronbach's alpha. The result showed the coefficient of 0.92 for the overall scale. Additionally, these coefficients were 0.87, 0.86, 0.68, 0.70, and 0.68 for factors such as specific nutrition, general nutrition, blood control, physical activity and weight control, and medical control, respectively.

Exploratory Factor Analysis: Data were used to analyze the factors of the 20-item DMSES. The Kaiser–Meyer–Olkin measure of sampling adequacy was 0.88, showing the sample was large enough to perform a satisfactory factor analysis. Bartlett's test of sphericity was significant (χ^2 = 2914.2, df = 190, P = 0.001), indicating that there were some relationships among the items. In this study, 5 factors provided the most meaningful factor pattern and accounted for 64.9% of the total variance. The factor loadings and factor structure resulting from factor analysis through varimax rotation are shown in table 1.

In CFA, the researcher examined whether the model identified by EFA fit the data. Mardia's coefficients of multivariate skewness and kurtosis were estimated to be 49.97 and 21.68, respectively. As these values were significant, robust maximum likelihood estimation procedures were used in this study. A covariance matrix and asymptotic covariance matrix were applied to estimate the model. The fit indices for the several alternative models are shown in table 2.

Table 1. Rotated factor analysis of DMSES

No	Items	F1	F2	F3	F4	F5
	Specific nutrition factor					
14	I am able to choose different foods and maintain my eating plan when I am away from home.	0.771				
15	I am able to follow a healthy eating plan during traditional ceremonies.	0.845				
16	I am able to choose different foods and maintain a healthy eating plan when I am eating at a party.	0.839				
17	I am able to maintain my eating plan when I am feeling stressed or anxious.	0.582				
13	I am able to follow a healthy eating plan when I am away from home.	0.736				
	General nutrition factor					
4	I am able to choose the foods that are best for my health.		0.648			
12	When doing more physical activity, I am able to adjust my eating plan.		0.659			
9	I am able to maintain my eating plan when I am ill.		0.749			
10	I am able to follow a healthy eating plan most of the time.		0.749			
5	I am able to choose different foods and maintain a healthy eating plan.		0.667			
	Blood glucose control factor					
1	I am able to check my blood sugar if necessary.			0.586		
2	I am able to decrease my blood sugar when the sugar level is too high (e.g., eat different foods).			0.831		
3	I am able to increase my blood sugar when the sugar level is too low (e.g., eat different foods).			0.770		
20	I am able to maintain my medication when I am ill.			0.522		
	Physical activity and weight control factor					
6	I am able to control my body weight and maintain it within the ideal weight range.				0.525	
8	I am able to do enough physical activity (e.g., walking, aerobic exercise, and stretching exercises).				0.798	
11	I am able to do more physical activity if the doctor advises me to do so.				0.786	
	Medical control factor					
7	I am able to examine both of my feet (e.g., for cuts or blisters).					0.525
19	I am able to take my medication as prescribed.					0.671
18	I am able to visit my doctor four times a year to monitor my diabetes.					0.751

As expected, the hierarchical model fitted more appropriately in comparison with other models. However, the overall fit indices did not reach the criteria of appropriate fit.

To improve the hierarchical model, investigators used the model modification tests, including the modification index (MI) and the T value. The MI suggested that additional covariance of error terms and cross-loading would improve the fit of the hierarchical model.

According to the highest modification index and conceptual meaning, item 21 cross-loaded on medical control factor. Moreover, investigators decided to add one correlation between errors of items18 and 21 (Table 2). Then, the T value indicated that item 21 should be dropped from blood control factor. All fit indices indicated that final modified model had a satisfactory goodness of fit.

Table 3 shows factor loadings and error variances of the final model. The correlations between the factors in the correlated model are shown in table 4.

Table 2. Fit index confirmatory factor analysis of DMSES

Model	χ^2	df	RMSEA (90% CI)	NNFI	GFI	AIC	AGFI	χ^2:df
One-factor model	1010.92	170	0.12 (0.12-0.13)	0.86	0.68	1090.92	0.60	5.95
Uncorrelated model	753.21	170	0.10 (0.09-0.11)	0.90	0.76	833.21	0.70	4.43
Correlated model	370.89	160	0.06 (0.05-0.07)	0.96	0.86	466.27	0.82	2.32
Hierarchical model	377.09	165	0.06 (0.05-0.07)	0.96	0.86	467.09	0.82	2.28
Modified model 1	359.07	164	0.06 (0.05-0.07)	0.97	0.86	451.07	0.83	2.19
Modified model 2	326.72	163	0.05 (0.05-0.06)	0.97	0.88	420.72	0.84	2.00
Final modified model	331.81	164	0.05 (0.05-0.06)	0.97	0.87	423.81	0.84	2.02

df: degrees of freedom; RMSEA: root mean square error of approximation; NNFI: Bentler–Bonnet non-normed fit index
CFI: Bentler–Bonnet comparative fit index; AIC: Akaike Information Criterion; AGFI: adjusted goodness-of-fit index; modified model 1, item 21 was cross-loaded in medical control factor; modified model 2, model with error covariance between item 21 and 18.

Table 3. Factor loading and error variance of final modified model

	Items	Factor loading	Error variance
	Specific nutrition factor		
14	I am able to choose different foods and maintain my eating plan when I am away from home.	0.75	0.25
15	I am able to follow a healthy eating plan during traditional ceremonies.	0.77	0.22
16	I am able to choose different foods and maintain a healthy eating plan when I am eating at a party.	0.67	0.29
17	I am able to maintain my eating plan when I am feeling stressed or anxious.	0.50	0.76
13	I am able to follow a healthy eating plan when I am away from home.	0.62	0.21
	General nutrition factor		
4	I am able to choose the foods that are best for my health.	0.52	0.32
12	When doing more physical activity, I am able to adjust my eating plan.	0.56	0.29
9	I am able to maintain my eating plan when I am ill.	0.58	0.29
10	I am able to follow a healthy eating plan most of the time.	0.59	0.19
5	I am able to choose different foods and maintain a healthy eating plan.	0.58	0.22
	Blood glucose control factor		
1	I am able to check my blood sugar if necessary.	0.91	1.93
2	I am able to decrease my blood sugar when the sugar level is too high (e.g., eat different foods)	0.82	0.26
3	I am able to increase my blood sugar when the sugar level is too low (e.g., eat different foods).	0.66	0.24
	Physical activity and weight control factor		
6	I am able to control my body weight and maintain it within the ideal weight range.	0.55	0.90
8	I am able to do enough physical activity (e.g., walking, aerobic exercise, and stretching exercises).	1.12	0.90
11	I am able to do more physical activity if the doctor advises me to do so	0.91	0.53
	Medical control factor (MCF)		
7	I am able to examine both of my feet (e.g., for cuts or blisters).	0.58	0.82
19	I am able to take my medication as prescribed.	0.45	0.42
18	I am able to visit my doctor four times a year to monitor my diabetes	0.36	0.63
20	I am able to maintain my medication when I am ill.	0.44	0.44

Table 4. Correlation among factors of the correlated model

Factors	F2 General nutrition	F3 Blood control	F4 Physical activity	F5 Medical control
F1: Specific nutrition factor	0.60	0.33	0.43	0.64
F2: General nutrition factor		0.55	0.61	0.66
F3: Blood glucose control factor			0.39	0.42
F4: Physical activity factor		0.56		

Discussion

The objective of this study was to translate and to evaluate the validity and reliability of the Diabetes Management Self-Efficacy Scale (DMSES) among the Iranian population. According to the results of the present study, the items were homogenous to the scale; as the mean and variance scores of each item and item-total correlation confirmed this homogeneity. Therefore, we used a spacious approach to increase efficiency, and to achieve the goals of cultural and functional equivalence.

The psychometric properties of the DMSES were studied in the present study. In this stage, results showed that the DMSES could work as a significant predictor of diabetes self-management. Furthermore, this study showed that DMSES accounted for 37.1% of the variance in the total DSM scores. This rate was nearly similar to the 33.6% reported in the study of Wu et al.[1] Therefore, DMSES higher scores equate with higher personal expectations of his/her ability to initiate and comply with diabetic self-management.

Construct validity of the DMSES was assessed through exploratory and confirmatory factor analysis. In contrast to the findings of the Chinese and Dutch version with 4 factors , in the present study 5 factors were generated (1, 11).

However, the structure of 5 clusters that was identified in the present study was similar to the Dutch and Chinese versions of the scale. The present study revealed 5 logical categories including: a) specific nutrition; b) general nutrition; c) blood glucose control; d) physical activity & weight control; and e) medical control. Subscales in the Iranian and Dutch versions were similar, but in the present study nutrition, general, and medical treatment subscales were transformed to two subscales. In the Iranian version of DMSES, the first factor was related to food or nutrition in special situations such as in a party, in a traditional ceremony, away from home, and with feeling stressed (including items 16, 14, 13, 15, and 17). Factor two was related to nutrition in general situations (including items 4, 5, 9, 10, and 12). Factor three was similar to blood sugar subscale in the Dutch version. Factor four was similar to physical exercise and weight factor in the Chinese version with a small difference in item 12 that loaded in general nutrition in the Iranian version. This difference is logical, because this item assesses the person's ability in nutritional change after physical activity change. Factor five was similar to medical treatment factor in the Chinese version with one item added (item 7) that was related to feet control.

Reliability of the Iranian version of DMSES was high with a value of 0.92 for the total scale and ranged from 0.68 to 0.87 for the subscales, which is in accordance with previous studies (21). This result is similar to findings reported for the English and Chinese versions (Cronbach's alpha, respectively, of 0.91 and 0.93), but it is higher than results reported for the original version (Cronbach's alpha = 0.81) of the DMSES (1, 11, 12).

Nevertheless, the use of convenience sampling may be thought to limit generality of the findings, but the results could be of major importance and significances to the diabetic patients in Iran.

This study showed that DMSES is a valid and reliable scale and could be used to measure self- management self-efficacy among Iranian patients who are suffering from diabetes.

The Iranian version of the DMSES will enable the identification of self-management activities in diabetic patients. Assessment of self-efficacy of patients should be an essential part of the nursing practice. Further studies may lead to the identification of variables that would improve this scale. At least, the items about specific nutrition and blood sugar control need critical evaluation; as it became clear that cultural factors make it impossible to use these two factors for the different populations under investigation. It is recommended that this scale be further evaluated with a large enough sample size, and in different regions in Iran and diverse populations of world.

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