Development and psychometric properties of perceived barriers scale (PBS) for self-care in middle-aged patients with diabetes mellitus type 2

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Journal of Research & Health
Social Development & Health Promotion Research Center
Vol. 3, No.2, 2013
Pages: 335-344
Original Article

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Received: 29 May2012
Accepted: 10 Dec 2012

How to cite this article: Naderimagham Sh, Nikkenami Sh, Abolhassani F, Hajizadeh E. Development and psychometric properties of perceived barriers scale (PBS) for self-care in middle-aged patients with diabetes mellitus type 2. *J Research Health* 2013; 3(2): 335-344.

Abstract

Appropriate self-care has an important role in improving the life level of diabetics and it has been proven that perceived barriers is one of the most contributory factors on the success self-carein diabetes. Thus, this study aimed to develop a scale for evaluating perceived barriers for self-care in middle-aged patients with diabetes mellitus type 2. The qualitative part of this mixed study was conducted in order to develop a preliminary item pool. In quantitative part, content and face validity, reliability (internal consistency and test-retest analysis), construct validity and factor analysis (exploratory and confirmatory) were performed for assessing psychometric properties of the scale. The 33-item questionnaire was developed through the qualitative phase. Exploratory factor analysis loaded a 23-item with a seven factor solution that jointly accounted for 64.75% of observed variance. The confirmatory factor analysis indicated a good fit to the data. Cronbach's alpha coefficient showed excellent internal consistency (α=0.80), and test-retest of the scale with a 2-week interval indicated an appropriate stability for the scale (ICC=0.89). The findings showed that the designed questionnaire was a valid and reliable instrument for measuring perceived barriers for self-care in middle-aged patients with diabetes mellitus type 2. It is a short and easy to use questionnaire and contains the most significant diabetes related self-care behaviors.

Keywords: Diabetes mellitus type 2, Middle-aged, Reliability, Self-care, Validity

Introduction

Diabetes mellitus type 2 is an increasing global concern predicted to rise sharply and to afflict more than 366 million people in 2030, mostly among the middle-aged [1]. Rapid rise of diabetes incidence ends in weakness of health care systems in responding to the growing needs of patients [2]. Due to this reason, patient's self-care is considered as the most important issue in preventing diabetes complications [3]. Self-care consists of self-motivated activities that enable patients to understand the conditions and factors which affect their health, decide to improve their health status, and put these decisions into practice [4].

There are different self-care activities to improve the health status of diabetic patients [5]. According to experts of the study; nutrition, physical activity, self-monitoring of blood glucose, foot care and smoking were chosen. Instead of the type of selected behavior, self-care might be possible if effective constructs are recognized. One of these constructs can be perceived barriers against performing self-care.

Perceived barriers is among the constructs and concepts of different theories and models related to health behaviors such as trans theoretical model [6], social cognitive theory [7] and health belief model [8].

According to the review of literature, there was only one instrument for measuring the perceived barriers of diabetic patients that examines the relationship between self-care behaviors and perceived barriers for adopting these behaviors in diabetic patients. The instrument has 77 items and 8 domains namely medication, self-monitoring of blood glucose, knowledge and beliefs, diagnosis, relationships with health care providers, lifestyle changes, coping with diabetes, and social support. The barriers against only one behavior (self-monitoring of blood glucose) of the 5 selected behaviors were examined by the Diabetes Obstacle Questionnaire (DOQ). Moreover, DOQ measures perceived barriers amongst patients with all demographic back grounds, while perceived barriers for self-care in patients with diabetes mellitus type 2 changes according to the demographic characteristics, and even, these barriers might be different among patients with the same demographic records [10]. Thus, this study aimed to design an appropriate scale to measure perceived barriers for self-care in diabetics based on age (30–60 years old) in a way that all 5 important self-care behaviors namely nutrition, physical activity, self-monitoring of blood glucose, foot care, and smoking can be assessed.

Method

The present mixed study was conducted for designing a scale to measure perceived barriers for self-care in diabetic patients from 2009 to 2011 in Tehran, Iran.

The instrument was designed according to perceived barriers part derived from thedecisional balance construct of Trans Theoretical model. This construct assumes that people's function is determined based on the balance or imbalance between their perceived positive and negative forces for adopting healthy behavior [11]. If the perceived barriers are superior to predicted benefits, the probability of adopting that behavior will reduce [12]. People behave according to analyzing the benefits minus the barriers of a behavior [13]. Some researchers believe that perceived berries are the most important dimension for predicting healthy behaviors [14].

In the present study, several methods were used to develop a data pool. These methods included literature review, interviews with expert panel, and a qualitative research to find perceived barriers against self-care of diabetic patients through 4 focus group discussions with 38 patients. Finally, a preliminary questionnaire was designed with 33 items, and later on, the stages of face and content validity were conducted.

To assess face validity, patients were asked about the 'difficulty', 'relevancy', and 'ambiguity' of the items. The impact score of each item was calculated using a 5-point Likert scale. Impact scores equal to 1.5 or higher were accepted [15].

Qualitative content validity was calculated based on 'grammar', 'wording', 'item allocation', and 'scaling' indices [15]. An expert panel consisting of 12 specialists in health education, nursing, and internal medicine studied the questionnaire and scored it according to the mentioned indices and their recommendations were inserted into the preliminary questionnaire. Quantitative content validity was determined by Content Validity

Ratio (CVR) and Content Validity Index (CVI). The expert panel scored each item using a 3-point Likert questionnaire including '1: essential', '2: useful but not essential', and '3: unessential' for calculating CVR. Then, the items with CVR0.56 or above were selected according to Lawshe's table [15]. Then, based on Waltz and Bausel recommendation [17], the panel evaluated the CVI of the questionnaire according to a 3-point scale. A CVI score equal to 0.8 or higher indicated the appropriateness of the content validity [18].

After the stages mentioned above, a little modification was made on the questionnaire but no item was deleted. Then, the construct validity and the reliability of the questionnaire were determined. To this end, a cross-sectional study was conducted and the samples were selected randomly from two diabetes screening centers affiliated to Tehran University of Medical Sciences. Inclusion criteria in the qualitative part of the study were: suffering from diabetes mellitus type 2 for at least one year, age between 30 to 60 years, HbA1c equal to 7 or higher in patient's record (or fasting blood sugar over 150 mg/dl), ability to speak in Persian, and willing to participate in the research. The Exclusion criteria were: the lack of lab test record, unwillingness to participate in the study, changing patients' address or telephone number, inability to speak or comprehend Persian.

Construct validity of the questionnaire was determined using exploratoryand confirmatory factor analyses. According to Knapp and Brown, the sample size for evaluating the exploratory factor analysis should be 3 to 5 times of the number of items [19]. On the other hand, a number of references have stated that the number of samples for this test should be 4 to 6 times of the number of items [20]. Since the number of items of the primary questionnaire was 33, a sample size of 198 subjects would be sufficient (6 times of the items). However, in order to compensate sample loss, ultimately, 204 people participated in the study and completed the questionnaire. Furthermore, in the exploratory factor analysis, a sample size more than 200 should have been recruited for achieving a significant chi-square [21]. Thus, a sample of 204 subjects could provide researchers' both objectives. All the information in 204 questionnaires was entered into exploratory factor analysis. Finally, factor structure of the questionnaire was determined by SPSS version 16 according to 'principal component analysis' with Varimax Rotation. In this study, two initial tests were used to examine data fitness for exploratory factor analysis: Sampling adequacy test of Kaiser Meyer Olkin and Bartlett's Test of Sphericity. In order to measure the number of factors, Eigenvalues higher than 1 and Scree Plot were used [22] and factor loadings equal or greater than 0.4 were considered acceptable [23].

A ratio of 1 item to 4 or 5 subjects in sample size is recommended for confirmatory factor analysis [24], but Monro suggests a sample size 10 times of the number of items [21]. In this section of the study, the questionnaire was completed by 198 patients apart from those who participated in the exploratory factor analysis. The fitness of the questionnaire was determined using correlation matrix by LISREL 8.80 software.

Researchers should consider several indices in order to determine the fitness of a model [21]. Therefore, Chi-square test, the ratio of Chi-square to degree of freedom, Comparative Fit Index, Incremental Fit Index, Normed Fit Index, Non-normed Fit Index, Root Mean Square Error of Approximation (RMSEA) and Standardized RMR were used. The values of CFI, IFI, NIFI and NNFI could range between 0 to 1. The values closer to 1 indicate better fitness of the data [25]. A RMSEA range between 0.08 and 0.1 shows a mediocre fit and values lower than 0.08 indicate a good fit [26]. The acceptable value for SRMR is less than 0.1. Values less than 0.08 show adequate fit, and values less than 0.05 indicate good fit [27].

Two methods were used for evaluating the reliability of the questionnaire: internal consistency, and test-retest. Internal consistency was evaluated by Cronbach's alpha for each dimension and for the total questionnaire. Cronbach's α coefficient of 0.7 or higher indicated acceptable reliability [27]. In this research, stability of the questionnaire was determined using test-retest method. In order to define the coefficient for re-examination of the instrument, 15 randomly selected patients completed the questionnaire twice with a 2-week interval. Test-retest coefficient of the scores was calculated using ICC and values equal to 0.4 or higher were considered acceptable [28].
Ethics committee of Tarbiat Modares University confirmed performing this study (52-11990), and all patients completed informed written consent.

Results

Quantitative and qualitative data were summarized as mean (Standard Deviation) and frequency (percentage), respectively.

In the qualitative part of the study, 38 patients with diabetes mellitus type 2 participated in group discussions. Of these, 25 (65.8%) were women. The mean age of patients was 45.7 years (±7.3). Most patients were married (89.4%) and the level of their education was elementary and secondary (55.3%). In the quantitative part of the study (exploratory factor analysis section), 149 of 204 patients (73%) were women. The mean age of participants was 50.6 years with standard deviation of 7.5 years and married people comprised most of the sample size (85.8%). Of 198 patients who were recruited for confirmatory factor analysis, 126 were women (63.6%) and their mean age was 46.8 years (±7.8). Married participants comprised most of the sample size (86.4%) and most of the patients had elementary and secondary education (68.2%) (Table1).

Table 1 *Demographic profile of the participants*

	Qualitative part (n=38)		EFA(n=204)		CFA (n=198)	
	Mean (SD)	n(%)	Mean (SD)	n(%)	Mea(SD)	n(%)
Age	45.7 (±7.3)		50.6 (7.5)		46.8(±7.8)	
Sexuality						
Female		25(65.8)		149(73)		126(63.6)
Male		13(34.2)		55(27)		72(36.4)
Education						
Illiterate		10(26.3)		38(18.6)		41(20.7)
Primary and secondary		21(55.3)		140(68.6)		135(68.2)
High school		6(15.8)		23(11.3)		17(8.6)
Higher		1(2.6)		3(1.5)		5(2.5)
Marital status						
Single		2(5.3)		4(2)		2(1)
Married		34(89.4)		175(85.8)		171(86.4)
Widow		2(5.3)		25(12.2)		25(12.6)
Employment						
Housewife		18(47.4)		132(64.7)		133(67.2)
Employed		8(21)		49(24)		61(29.9)
Student		2(5.4)		0(0)		0(0)
Unemployed		5(13.1)		3(1.5)		1(0.7)
Retired		5(13.1)		20(9.8)		3(2.2)
Body Mass Index (kg/m^2)	29.6(±4.2)		29.7(±4.2)		29.8(±4.8)	
Disease duration (year)	8.2(±5.4)		9.1(±5.6)		11.2(±6)	

Table 2 *The perceived barriers scale (PBS) for self-care in middle-aged patients with diabetes mellitus type 2 and its factor loading (N=204)*

Items	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
1. Barriers related to the educational method used by the educator	0.229	0.150	0.711	0.201	0.096	0.038	0.036
2. Barriers related to the comprehension of written educational material	0.054	-0.044	0.762	-0.214	0.128	0.058	0.161
3. Inadequacy of the presented information	0.144	0.007	0.746	0.012	0.065	0.190	0.153
4. Barriers of observing diet out of home	0.154	0.162	0.358	0.293	0.174	-0.092	0.439
5. Barriers related to interest in inappropriate foods	0.104	-0.048	0.205	0.069	-0.059	0.111	0.695
6. Unfamiliarity with appropriate foods	0.014	0.026	0.063	-0.108	0.067	0.007	0.658
7. Not affording sports classes	0.691	0.111	0.136	-0.213	0.132	0.042	0.178
8. Disinterest in exercising	0.818	0.013	0.067	0.173	0.014	-0.043	0.034
9. Lack of time to exercise	0.556	-0.028	-0.018	0.245	0.205	0.119	-0.050
10. No motivation to exercise	0.724	0.063	0.107	0.273	0.211	-0.126	-0.033
11. Laziness to do physical activities	0.707	-0.003	0.244	-0.123	0.006	0.110	0.158
12. Not having glucometer because of its high price	0.094	0.067	0.131	0.100	0.122	0.912	0.019
13. High cost of blood sugar test strips	-0.026	0.016	0.110	-0.139	0.101	0.914	0.055
14. Inability to measure blood sugar by glucometer	0.054	0.114	0.336	0.193	0.613	0.215	-0.276
15. Not knowing the meaning of numbers on glucometer	0.232	0.021	0.132	0.275	0.739	0.143	-0.104
16. the problem of measuring blood sugar on business	0.192	0.023	0.151	-0.120	0.624	0.099	0.281
17. Difficulty in measuring blood sugar when busy	0.086	0.019	-0.101	-0.039	0.579	-0.078	0.463
18. Not knowing how to care feet	0.126	0.262	-0.065	0.813	0.151	0.018	0.001
19. Disinterested in foot care	0.080	0.170	0.060	0.838	0.005	-0.047	-0.027
20. Inability to stop smoking while facing problems and stress	-0.033	0.829	-0.077	0.072	-0.013	0.024	0.064
21.Patients' beliefs that smoking does not affect diabetes	0.124	0.692	-0.062	0.177	-0.031	0.025	0.090
22. Not finding appropriate alternatives for smoking	0.051	0.844	0.090	0.072	0.011	0.036	-0.081
23. Lack of support from others to quit smoking	-0.031	0.734	0.215	0.105	0.166	0.001	-0.041
Eigenvalue	4.761	2.788	2.069	1.692	1.311	1.222	1.050
Explained Variance (%)	20.699	12.123	8.998	7.355	5.702	5.313	4.564
Cumulative Variance (%)	20.699	32.822	41.819	49.175	54.876	60.189	64.753

Since the impact score of all items in face validity phase was a little higher than 1.5, all items were kept in the questionnaire for further analyses. For the qualitative face validity, some changes were made in the questionnaire according to the patients' opinions and for the qualitative content validity, expert panels' recommendations were inserted into the questionnaire. For assessing the quantitative content validity, Content Validity Ratio and Content Validity Index were calculated. There was no need to eliminate any item, and a 33-item questionnaire with a 5-point Likert scale was designed. Then, the construct validity of the questionnaire using exploratory and confirmatory factor analyses as well as the reliability was calculated. Result of the Kaiser-Meyer-Olkin test (KMO=0.74) and Bartlett's test of sphericity (χ^2=1.59; P<0.001; df=253) on 204 patients showed sampling adequacy. This result indicates the obvious relationship between variables; therefore, we could use "principal component analysis" by

Varimax rotation to determine subscales. Items with factor loading equal to 0.4 or higher were considered as a dimension. Eigenvalues higher than 1 and scree plot were used for determining the number of dimensions. Then, 10 items that were loaded in irrelevant dimensions or their loading factor was lower than 0.4 were removed, which resulted in a 23-item questionnaire with 7 dimensions. This questionnaire could explain 64.75% of observed variances. Table 2 shows loading factor of each item after Varimax rotation. Loading factor ranged between 0.439 to 0.914.

Factor1: Physical activity, Factor 2: Smoking, Factor3: Educational barriers, Factor 4: Foot care, Factor 5: Personal barriers for self-monitoring of blood glucose, Factor 6: External barriers for self-monitoring of blood glucose, Factor 7: Nutrition

In the above table, factor loading equal to 0.4 or higher of every item has been shown in bold font.

Ultimately, the questionnaire was completed by another group of 198 patients who were selected randomly, and confirmatory factor analysis was used for the 23-item questionnaire. Relative Chi-square was equal to 1.61, which indicated fitness of the model. Comparative indices of the model including CFI, IFI, and NNFI were higher than 0.9 (respectively; 0.93, 0.93, 0.91) and NFI was equal to 0.85. RMSEA of the model was 0.056 (confidence interval 90%=0.044-0.066) and standardized RMR was lower than 0.080 (0.077). Both of these indices indicated good fit of the model (Table 3).

Table 3 *Fit indices of perceived barriers scale (PBS) for self-care in middle-aged patients with diabetes mellitus type 2*

standardized RMR	NNFI	NFI	IFI	CFI	RMSEA	χ^2	df	Relative χ^2
0.077	0.91	0.85	0.93	0.93	0.056	336.07	209	1.61

Cronbach's alpha coefficient equaled 0.80, which showed appropriate internal consistency and ICC equal to 0.89 assumed the stability of the questionnaire (Table 4).

Table 4 *Cronbach's α coefficient and ICC for the Perceived Barriers Scale (PBS) for self-care in middle-aged patients with diabetes mellitus type 2 (N=198)*

	N of items	Mean (SD)	Cronbach's α coefficient	ICC
Educational barriers	3	2.95 (1.04)	0.68	0.88
Nutrition	3	3.02 (0.97)	0.57	0.75
Physical activity	5	2.92 (1.00)	0.78	0.83
External barriers for self-monitoring of blood glucose	2	2.86 (1.55)	0.89	0.92
Personal barriers for self-monitoring of blood glucose	4	3.06 (1.00)	0.68	0.82
Foot care	2	3.32 (1.33)	0.81	0.84
Smoking	4	3.37 (0.71)	0.79	0.91
Total	23	3.05 (0.57)	0.80	0.89

Discussion

The present study aimed to report the development and psychometric properties of a scale in order to measure perceived barriers of self-care in middle-aged patients with diabetes mellitus type 2. Results showed the appropriateness of psychometric properties of the questionnaire. Perceiving the barriers, comparing those barriers with the benefits of adopting a behavior, and finally, superiority of advantages over barriers, initiate the self-care behavior by diabetic patients [12]. In the next step, it is necessary that patients recognize the barriers. Since there was no appropriate instrument for assessing the

perceived barriers of selected behaviors, the present study was essential and was done to design a questionnaire for evaluating this construct. As far as researchers could access the literature, only one questionnaire was found for assessing perceived barriers of multiple self-care behaviors in diabetic patients [9], and other questionnaires assessed the barriers in specific domains of self-care behaviors in patients with diabetes mellitus type 2 [29, 30].

'Diabetes Obstacle Questionnaire' is an instrument consisting of 113 items, which assessed 180 patients. Exploratory factor analysis resulted in deleting 36 items, and a questionnaire with had 77 items was developed. KMO of the instrument was 0.75 and Cronbach's alpha was greater than 0.75. The instrument consists of 8 domains: medication, self-monitoring of blood glucose, knowledge and beliefs, diagnosis, relationships with the health care providers, life style changes, coping with diabetes, and social support. Meanwhile, the present study examined 204 patients in exploratory factor analysis phase, KMO was 0.74 and Cronbach's alpha was 0.80. Since KMO between 0.7 and 0.8 indicates a balanced factor analysis, [22] the adequacy of both instruments is confirmed. The designed questionnaire in the present study consists of 7 domains: educational barriers, nutrition, physical activity, external barriers for self-monitoring of blood glucose, personal barriers for self-monitoring of blood glucose, foot care and smoking. These 7 dimensions explain 64.75% of total observed variance. This variance is acceptable and it can reveal main features of the subject [31]. After exploratory factor analysis and deleting a number of items, all primary theoretical dimensions were inserted into 7 factors that indicated exact selection of samples and appropriate conceptual framework of the present study [32], and showed appropriate process of designing a Perceived Barriers Scale (PBS) for self-care in middle-aged patients with diabetes mellitus type 2. In addition, contrary to DOQ, we used both exploratory factor analysis (on 204 patients) and confirmatory factor analysis (on 198 patients). Goodness of Fit indices such as the ratio of Chi-square to degree of freedom was less than 3; CFI, IFI, and NNFI were higher than 0.9, RMSEA was less than 0.08 and SRMR was less than 0.1 and within the acceptable range. Confirmatory Factor Analysis confirmed the construct validity of the questionnaire too.

Since the reliability of the questionnaire increases the power of the study in distinguishing the real significant differences and correlations in the study [31], after designing the questionnaire, Cronbach's alpha coefficient was calculated to estimate internal consistency of all dimensions of and total questionnaire. Internal consistency of the final version of the instrument was 0.80, ranging 0.57-0.89. The alpha closer to 1 shows more reliability of the questionnaire, and appropriate Cronbach's alpha coefficient in each dimension shows that the items in that dimension are good representatives of its content [33], therefore, based on the mentioned Cronbach's alpha coefficient, the reliability of the instrument was appropriate. Furthermore, test-retest confirmed the reliability of the instrument as well. One of the features of this study is its detailed items as compared with conventional foreign questionnaires. This difference can be attributed to cultural differences between Iranian patients and patients in other countries, or Iranian patients' interest in detailed items. In addition, in qualitative phase of the study, patients with different demographic backgrounds were invited to group discussions to make generalization possible. However, further studies are needed

in order to generalize the results of this study to other populations. Measurement of barriers against 5 important self-care behaviors by 23 items is one of the advantages of this instrument, as using few number of items can prevent biased and probably wrong answers given by patients. One of the limitations of this study is that we did not measure discriminated validity, and we recommend measuring this type of validity in further studies.

Conclusion

According to the findings of the present study, 'the Perceived Barriers Scale (PBS) for self-care in middle-aged patients with diabetes mellitus type 2' is an objective and easy to use instrument that can evaluate barriers of self-care in this group of patients.

Contributions

Study design: SHN; Data collection and analysis; Manuscript preparation: AH, SHN

Conflict of interest

"The authors declare that they have no competing interests."

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