



Adaptation and Validation of the Problem Solving Scale for Patients with Type 2 Diabetes Mellitus

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JSRR/2015/19351

Editor(s):

(1) Karl Kingsley, University of Nevada, Las Vegas - School of Dental Medicine, USA.

Reviewers:

(1) Anonymous, University of Arkansas for Medical Sciences, USA.

(2) Alexander Sabre, Universidad Autonoma de Guadalajara, Mexico.

Complete Peer review History: <http://sciencedomain.org/review-history/10434>

Original Research Article

Received 5th June 2015
Accepted 23rd July 2015
Published 5th August 2015

ABSTRACT

Objective: To test the psychometric properties of the health problem solving scale (HPSS) adapted for adults with type 2 diabetes mellitus (T2DM).

Study Design: Cross sectional study, scale validation.

Methodology: 238 T2DM patients from 18 to 70 years of age (Mean =64.81 years, SD =11.186) participated in diabetes monitoring at the Mexican Diabetes Association in Monterrey Nuevo León. To validate the content of the scale, the Delphi method of consultation of experts was used. The construct validity was determined by confirmatory factor analysis.

Results: The adaptation of the Problem Solving in Diabetes Self-Management Scale consisted of a scale with 19 items distributed in three dimensions. Prior to factor analysis, the assumptions of normality, homoscedasticity, and linearity were made, and a sample size larger than 50 subjects was obtained. The measurement of sample adequacy was above the maximum acceptable value of 0.50, with a value of .853. Bartlett's test of sphericity was significant ($X^2 = 1301.040$, $gl = 171$, $p < .001$). In the confirmatory factor analysis by principal components with orthogonal method rotation

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of 19 items, three factors were found with eigenvalues greater than 1, which together explained 48.9% of the total variance. The first component explained 27.6% of the variance, the second component explained 13.3%, and the third component explained 7.9%.

Conclusion: The scale is brief and easy to apply and could be used in health and community institutions to understand how T2DM patients solve problems, either in an effective (positive) or a careless/avoidant or impulsive (negative) manner. It could also be useful to guide the design of strategies that can direct patients to cope with the problems that they face when caring for their diabetes.

Keywords: Problem solving; diabetes mellitus; questionnaire validation.

1. INTRODUCTION

Type 2 diabetes mellitus (T2DM) represents one of the major public health problems in Mexico, causing the highest overall mortality and morbidity [1]. T2DM is a chronic disease, in which the patient is expected to be responsible for its management. According to the National Health Survey (ENSANUT 2012 for its acronym in Spanish) of all Mexican people with T2DM only the 24.5% presented evidence of adequate metabolic control, this low percentage of people with adequate control suggests that is poor the compliance to the T2DM treatment [2].

Even though there many factors that might contribute to inadequate metabolic control, one could be lack of solving problems skills given that most of patients with T2DM belong to a social security institution where they receive treatment advice and medications free. Therefore it is important to learn if Mexican adults with T2DM have developed problem solving abilities related to T2DM's treatment [3,4].

The disease management includes self care behaviors related to healthy diet, exercise, glucose monitoring, and medications among others, in order to keep blood glucose levels under control [5]. Over time patients need to identify if their behaviors are contributing to keep under control or not their glucose levels.

For problem solving patients with T2DM need to identify and formulate the problem, generate alternative solutions, decision-making, implementation and verification of the solution. The development of these skills will allow making judgments and deciding what to do about their self-care [6]. Thus, problem solving is a necessary skill for effective management of the diabetes mellitus [7].

Few studies have examined self-care behaviors as factors associated with problem solving for good glycemic control in patients with T2DM

[3,4,8]. The concept of problem solving has been addressed as a general process of making decisions and not as an approach to managing specific problems that patients with T2DM face in daily life in relation to their T2DM care [8,9]. A scale of problem solving has been created for healthcare issues [9], and an inventory of problem solving [6] has been formulated. Those authors suggest the need for the development of particular instruments that assess the problem solving of patients regarding the management of their diabetes [3,6,9].

The Health Problem/Solving Scale (HPSS) [9] was adapted to learn how patients with T2DM solve problems (effective, impulsive/careless, or avoidant) in relation to the management of the T2DM disease. This scale may help health service educators to focus on important aspects of management of T2DM for better control of the disease and to delay complications.

The objective of this study was to test the psychometric properties of the HPSS adapted for adults with T2DM who attend to the Mexican Diabetes Association in Monterrey, Nuevo León to learn about the disease management. Another aim was to explore convergent validity of the HPSS en relation to the Summary of Diabetes Self-Care Activities (SDSCA) questionnaire (Toobert & Glasgow, 2000), and to results of glycosylated hemoglobin (A1C) of a sub-sample of 50 participants.

2. METHODS

Adaptation of the Problem Solving in Diabetes Self-Management Scale (La Escala de Resolución de Problemas en el Autocuidado de Diabetes - ERPACD). Before formulating the items of this scale, the HPSS was translated from English to Spanish by a bilingual health professional whose native language is Spanish [10]. Subsequently, it was revised and improved by a professional translator whose native

language is English. Both versions were compared to verify whether the questions retained the same sense and meaning. After this process, the Spanish version of the instrument was obtained, consisting of 50 items grouped in seven scales in the same format as the original.

The consultation of experts method (Delphi) was used [11] to assess content validity. Following the criteria of a group of authors who have applied the Delphi method in their research, a methodological sequence was established, which was composed of three main phases: preliminary, exploratory and final [12-15].

2.1 Preliminary Phase

In this phase, the adaptation of the Problem Solving in Diabetes Self-Management Scale was carried out. The adaptation consisted of particularizing the health situations presented in the items towards the recommendations of diet, exercise, and medications in people with T2DM. From the original scale, which is translated from the HPSS in English and consisted of 50 items, 20 items were not included because they were deemed repetitive, and eight items were added; two items concerned the actions taken if a patient forgets their medication, and the other six were related to consequences or problems in the case that self-care for nutrition, exercise, and taking medications were not performed. A total of 38 items remained. Once the first version of the questionnaire was completed, the following actions were taken.

2.2 Exploratory Phase

The first version underwent an initial review for content validation with the group of experts to receive their expert judgment regarding whether the items included were related to problem solving during self-care for diabetes. They were asked their opinion on each item, which was rated on a scale of 1 to 5 (1, not related to the concept and 5, totally related and did not require modifications). In the case that the item required modifications, the experts were asked to note the changes in a row under each item.

Sending and receiving observations and comments regarding the scale was performed by email in a file attachment, which was made up of one page with a brief introduction to the research topic and explained the objective of the review and instructions for completing the questionnaire. The comments and suggestions from the first

review of the consultation with the group of experts were analyzed by applying the Delphi methodology described by Goodman [11]. The suggested correction was to separate those items regarding problem situations into three observable behaviors. The observation was that the patients could have a positive opinion regarding one of the behaviors and not of the others. Thus, the total number of items was increased to 42. In addition, some terms were adapted that were more appropriate to the study population, for example, the item "dealing with problems" was changed to "I left it for later," and the term "diet" was changed to "nutrition."

Once the questionnaire was modified according to the suggestions of the first review, the scale underwent a second review by consulting a member of the group of experts with the aim of ratifying the modifications. In this review, five items that appeared unclear were eliminated, and the remaining scale included 37 items.

2.3 Final Phase

The questionnaire was applied to 238 T2DM patients from 18 to 70 years of age (Mean =64.81 years, *SD* =11.186) who participated in monitoring at the Mexican Diabetes Association in Monterrey, Nuevo León. Adults with an obvious physical disability that could potentially interfere with the activities of self-care were excluded. This situation was verified by simple questioning. Pregnant women or those who were lactating, as verified by a direct question, were also excluded because they can present changes in glucose metabolism related to gestation or lactation (ADA, 2010). Regarding sex, 142 (59.7%) participants were women and 96 (40.3%) were men; 39.6% indicated that they were homemakers. A total of 71.4% of participants lived with a partner, 13.5% were divorced or widowed, and 15.1% were single. A total of, 17.2% of participants he said were pensioned or retired, 20% were professionals, and the remaining participants worked as taxi drivers, street vendors, electricians, and private drivers, among other professions. The convergent validity was analyzed by applying Spearman's rank correlation coefficient to the scores obtained from the Toobert & Glasgow's Questionnaire of Diabetes Self-care Activities, [16] the Health Problem-Solving Scale for patients with T2DM, and a small random sample of 50 A1C patients.

3. RESULTS AND DISCUSSION

The construct validity of the Problem Solving in Diabetes Self-Management Scale (Appendix) was evaluated through analysis of factor extraction with principal components. Prior to factor analysis, the normality factors, homoscedasticity, and linearity were assumed, and a sample size greater than 50 was obtained; later, a Varimax orthogonal rotation was applied to the components matrix. The factors were interpreted from the matrix of configurations, and loads greater than or equal to .30 were considered. It is worth mentioning that of all of the factors loaded, some factors had loads above .30.

The criteria used to evaluate each item consisted of the matrix of inter-item correlations and the correlation of the total corrected items, where the internal consistency was estimated by Cronbach's alpha coefficient (α). Internal consistency values less than .60 were considered low, values from .60 to .69 were considered adequate, and values of .70 or greater were considered high [17] (Table 1).

The Kaiser-Meyer-Olkin (KMO) test was conducted to confirm that the sample was adequate for factor analysis. The sample adequacy measure obtained was above the maximum acceptable value of 0.50, with a value of .85. Bartlett's test of sphericity ($X^2 = 1301.040$, $gl = 171$, $P < .001$) was significant. It was concluded that the correlation matrix was suitable for factoring. The confirmatory factor analysis was performed by principal components with orthogonal rotation, which allows for interpretation of the total explained variance (Varimax), and 11

factors were found with eigenvalues greater than 1. However, it was observed when more than three factors were included; the explained variance was less than 5%, which is why only the first three factors were considered items. The original scale that guided the adaptation obtained acceptable reliability coefficients $> .80$.

The first three factors explain 48.9% of the total variance. The first factor (11 items) corresponds to the avoidant and careless styles from the original scale and explains 27.6% of the variance. The second factor includes five items that correspond to the effective style and explains 13.3% of the variance. The third factor includes three items from the effective style section of the original scale and explains 7.9% of the variance (Table 2).

In the rotated component matrix, all of the items were loaded into one of the three categories. Table 3 shows that the lowest load was .48.

3.1 Convergent Validity

The results of this study regarding convergent validity show a significant relationship between the scale of problem solving in Self-care of Diabetes and the questionnaire of self-care activities; however, when correlating the A1C values with the scale of problem solving in self-care, there was no significant relationship. The A1C values only showed a significant relationship with the questionnaire of self-care activities. A higher number of care activities indicated a lower A1C value; more problem solving using the effective style indicated better self-care; and more problem solving using the avoidant style indicated lower self-care (Table 4).

Table 1. Reliability of the problem solving in diabetes self-management scale

Scale	Items	Cronbach's Alpha
Problem solving for patients with T2DM	19	.838
Negative problem solving subscale (avoidant, impulsive/careless)	11	.869
Positive problem solving subscale (effective)	5	.843
Positive problem solving subscale (effective)	3	.523

Note: $n=238$

Table 2. Variance of factors from the problem solving in diabetes self-management scale for patients with T2DM

Factor	Number of items	Eigenvalue	Explained variance%	Accumulated variance%
1. NPS (avoidant, impulsive/careless style)	11	5.11	27.6	27.6
2. PPS (effective style)	5	2.53	13.3	41.0
3. PPS (effective style)	3	1.52	7.9	48.9

NPS=Negative Problem Solving; PPS=Positive Problem Solving

Table 3. Items and load factors from the problem solving in diabetes self-management scale

Items	Component		
	1	2	3
21. Although I have problems with my diabetes, I continue to do things that affect me such as eating poorly, not exercising or not taking my medications.	.775		
18. I prefer to eat what I want instead of eating the foods suggested for taking care of my diabetes.	.768		
17. Sometimes I know that I am doing the wrong thing for caring for my diabetes, but I cannot stop doing it.	.759		
30. I eat what I want even if it makes my sugar go up.	.715		
27. Over time, it becomes increasingly difficult for me to manage my problems with my diabetes care.	.690		
14. I often forget to follow treatment so that my diabetes improves.	.656		
6. Sometimes I decide not to do what I should do to take care of myself, and I do what I want.	.621		
29. I feel there is nothing I can do with the problems that arise with my diabetes.	.585		
22. If I do not feel like exercising, I decide not to do it.	.548		
20. If I see that my family or friends with diabetes do what they want, this motivates me to do what I want to do.	.531		
13. When I have a problem with my diabetes care, I feel so annoyed that I do not know how to deal with it.	.488		
11. I know that the decisions to take or not take medications for diabetes make the difference in my blood sugar results.		.780	
10. When I think about the complications that I can have as a result of my diabetes, I want to do more to take care of my health.		.700	
12. When I have a problem with my diabetes care that I do not know how to deal with, I look for advice/help to resolve it.		.670	
15. I know what type of problems I can have if I do not take medications for diabetes.		.590	
9. I know what problems I can have if I do not take care of my diet.		.482	
1. I know that what I decide to eat makes the difference in my blood sugar results.			.693
4. I know that my decisions on exercising or not exercising make a difference in my blood sugar results.			.691
2. I know what type of problems I can have if I do not do exercise.			.646

Note: n=238

Table 4. Correlation between the subscales of problem solving in diabetes self-management, questionnaire of diabetes self-care activities, and A1C values

	A1C	QDSA	APS	EPS
A1C	-			
QDSA	-.28	-		
APS	.43	-.26**	-	
EPS	-.76	.17**	-	-
Total scale	-.01	.28**	-.95**	.53**

A1C=Glycated hemoglobin; QDSA=Questionnaire of Diabetes Self-care Activities; APS=Avoidant Problem Solving; EPS=Effective Problem Solving; ** P=.01

4. DISCUSSION

The HPSS scale in its Spanish version does not show the same factorial structure in patients with T2DM as the original version in English. The results of the adaptation of the Problem Solving

in Diabetes Self-Management Scale produced a scale of 19 items distributed in three dimensions, unlike the original scale, which consists of seven factors. Unlike the original scale, the participants from this study did not discriminate between an impulsive/careless problem solving style and an

avoidant problem solving style; the items of such styles were grouped into a single factor. This finding suggests that Mexican patients with T2DM perceive the items as a single negative style that could be called avoidant/careless. Of the total items of the effective style (9) of the original scale, eight were grouped into two factors. Five were grouped into the second factor, and only three were grouped into the third factor. The second factor is related to aspects and consequences of treatment, even though diet is included, and factor three includes one item related to diet and two related to exercise.

The adapted scale showed good internal consistency and acceptable psychometric properties; indicators of goodness of fit from factor analysis verify the construct validity of the structure in three dimensions. This finding is supported by the opinion of the author of the HPSS; she refers to the need to reduce the number of elements of the scale for greater efficiency [6]. When assessing convergent validity, no significant association was found between A1C values and patient answers. The patients report taking good care of themselves, but this is not reflected in their A1C values; this result could have occurred because the patients commented about receiving no adjustments in their medications since diagnosis. According to the American Diabetes Association (ADA), which states that if in three months the A1C goal is not reached, in addition to intensifying changes in lifestyle, drug therapy should be adjusted to reach control targets [18].

In this study, unlike the Hill-Briggs study, no association was found with A1C values; in the original HPSS scale, the author reports an association of the effective style with A1C values: better problem solving led to lower A1C numbers. However, this study shows a significant association between the Problem Solving in Diabetes Self-Management scale and the Questionnaire of Diabetes Self-care Activities; when better care was reported by participants, the A1C numbers were lower. In addition, the Questionnaire of Diabetes Self-care Activities showed a significant association with the styles (avoidant and effective) of the problem-solving scale; a more effective problem solving style led to better problem solving, and a more avoidant problem solving style led to decreased self-care reported by patients.

We observed that patients who do not receive follow-up regarding the effectiveness of drugs

could explain the lack of association between the self-care reports and the A1C values.

5. CONCLUSION

The Spanish version of the Problem Solving in Diabetes Self-Management Scale with 19 items configured in three dimensions has sufficient psychometric characteristics to suggest that it is suitable for measuring problem solving in adults and older adults. The scale is considered short and easy to apply and could be used in health and community institutions to evaluate the manner in which patients with T2DM solve problems, whether in an effective (positive) or careless/avoidant or impulsive (negative) manner. It could also be useful in guiding the design of strategies that can direct patients in coping with the problems that they face in the care of their diabetes.

This validation is newly emerging; it is recognized that the validation process requires new studies to confirm the structure proposed for the adapted version, both in other populations as well as in other age groups and health institutions. It may be necessary to modify or add appropriate items for the Mexican population. It is worth mentioning that the adaptation of the instrument to Spanish did not maintain the same configuration of the original scale.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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- my diabetes condition, I do not waste time looking for other ways to get good results.
33. I avoid food, activities, places or environments (parties) I know that my diabetes worse.
34. I would rather stay in bed than deal problems of my diabetes.
35. If my family or friends have problems with their diabetes, I know that what happened to them is going too happened to me.
37. When I am having problems with my diabetes care, do not tell my doctor, my nursing or nutritionist.

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Peer-review history:

*The peer review history for this paper can be accessed here:
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