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CONSTRUCTION AND VALIDATION OF "DIABETES EDUCATION PROCESS (DEP)" SCALE

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Abstract

Nursing interventions in diabetes education are considered relevant in order to achieve proper outcomes. It is important to know what nurses do in this field and for this purpose we need valid and reliable instruments. Objective: To develop and determine the psychometric characteristics of Diabetes Education Process Scale (DEP). Methods: Based on the question "What interventions nurses develop in their practice in diabetes education?", we developed two studies: (a) a qualitative one in order to identify relevant variables to measure in diabetes education; and (b) a quantitative and methodological study of validation of DEP scale. Results: We identified four guidelines in qualitative study through

which emerged the relevant variables for the evaluation of therapeutic education. We applied this DEP Scale to a sample of 104 nurses, with an average age of 41.3 years (SD = 8.1). DEP Scale has in its dimensions α values between 0.6720 and 0.834, revealing reasonable internal consistency. The scale revealed also validity characteristics. Conclusion: We concluded that it is important to know nurses practices in order to let emerge their contribution to patient care. For this purpose, we need valid and reliable instruments. DEP Scale proved itself to be valid and reliable, so it can be used to access nurses´ interventions in diabetes education.

Keywords

Diabetes Mellitus; Therapeutic Education; Validation Studies

1. Introduction

Chronic conditions represent today one of the most important threats and challenges in health matters, with particular concern to the increasing incidence and prevalence, associated with the aging population and technological progress. Within this reality, we face new challenges for the organization of health care, the articulation between the various levels of care and their financing, amid growing expectations of the population and the reduction of available resources. It is considered that the issue of financial constraints is currently the most important and cross-cutting issue by its negative effects in the capacity of people to resort to health services as well as quality of care provided to them (European Hospital and Healthcare Federation, 2010).

An inadequate metabolic control of diabetes stills reported and evidence states that the non-achievement of these results is related not only to the patient characteristics, but also to the care and the organization of health systems (Nam, Chesla, Stotts, Kroon, Janson, 2011). In Portugal, despite the existence of education programs for patients with diabetes, it is recognized that the evaluation of this programs is still incipient (Campos, Saturno, Carneiro, 2010). There is a need for further studies to evaluate the educational programs wich have been implemented (Menino, Dixe, Louro, Roque, 2013). For this purpose, we need valid and reliable instruments.

Our goal while developing this study was the development and determination of the psychometric characteristics of DEP, an instrument that measures the interventions adopted in the patient education in diabetes. The reliability and validity are two essential qualities to any measuring instrument (McDowell, 2006; Streiner, Norman, 2008). The evaluation of these qualities is essential while building such a tool (Fortin, 2009).

2. Method

The construction process of DEP scale was preceded by a review of the literature in order to identify the important variables to measure this construct.

With regard to bibliographical sources, we chose only contemporary sources, seeking to official documents accessible on trusted websites related to Diabetes , and providing specific guidelines in the area of diabetes education in general or applicable to Diabetes care nursing. We used documents not restricted to members of those communities. For this purpose, we did our research on pages from associations in the field of Diabetes and official pages in health area, using the search key terms "Guidelines", "Diabetes" and "Education".

Since the objective was to identify guidelines for the practice of education in the field of diabetes, we selected guidelines of general scope, applicable to any diabetes educator in the area or specific guidelines for the nursing area. With this strategy, we did not find any specific guidelines for the Nursing area. Most of the guidelines were aimed to be implemented by professionals providing care in the area of diabetes, and more specifically were designed for diabetes educators.

Evidence indicates that nurses play an important role in diabetes therapeutic education, thus it was considered that the identified guidelines, although not specific for nurses activities, could be applied as guidelines to nursing practice in the field of diabetes education.

Guidelines from the past five years (2008-2012) are included in the study, with references to the studies they were based upon, so that they could be referred to for clarification on some content issues or concepts.

We conducted a content analysis of these guidelines in order to identify the categories of recommendation related to education in the area of diabetes.

According to the inclusion criteria, the guidelines we selected, and which constitute the source of data for later analysis are listed in Table 1 which describes the contextual characteristics of the guideline for a better understanding.

We used content analysis to process the data, since we wanted to use systematic procedures of analysis to obtain categories and indicators that aggregates these messages (Bardin, 2009).

From the analysis of these guidelines, we were able to determine the relevant variables to assess the process of therapeutic education.

After having built the instrument which assesses the process of diabetes education, we submitted it for review to a group of five experts, in order to verify the adequacy of the questions, and the scale in general.

For the constitution of this group of experts, we considered the criteria recommended in the literature, having made an adaptation of Fehring (1987) criteria. The group of experts had an experience in diabetes area as a nurse for at least five years, with grade master in nursing and publications in the area.

Thus, each expert was informed about the purpose of the questionnaire as well as the procedures to implement it. For each question, the expert had to judge its suitability and intelligibility. At the end of the questionnaire, they were asked to make suggestions and give their opinion about the questionnaire as a whole.

The items to which we obtained a concordance equal or higher than 75% remained with no changes (Chang, Gardner, Duffield, Ramis, 2010). The items requiring some changes were sent again in a second round with suggested changes, asking the experts to express their views on the adequacy and intelligibility again. In the second round there was an agreement higher than 75% for all items.

Given the review of the literature performed, we considered as appropriate the development and application of two scales that measure different constructs, which have been identified as essential in the field of therapeutic education for patients with type 2 diabetes: a scale consisting of several indicators which feature in the intervention process in diabetes education (DEP Scale); another scale specific for interventions focused on each self-care behaviour.

This quantitative and methodological study focuses on the first scale: DEP scale.

In order to determine psychometric characteristics, we first analysed the construction validity, through factor analysis, which assumes that there is a smaller number of unobservable variables underlying the data (factors), which express what is common in the original variables (Pestana & Gageiro, 2005).

The items with factor loadings greater than 0.30 were kept, since they revealed a good correlation between the item and the factor (Almeida & Freire, 2007).

In order to apply the factor analysis, we considered that the correlation between variables was necessary.

The Kaiser-Meyer-Olkin (KMO) and Bartlett's tests were the two statistical procedures to which we referred to assess the quality of the correlations between variables, in order to proceed with the factor analysis (Pestana & Gageiro, 2005).

The objective of the factor analysis is to find common factors in a group of variables, so it is essential that the sample is large enough. It was then decided to consider the predicted by Bryman and Cramer (2003) and Hair, Hult, Ringle, Sarstedt (2013) indicating that N for considering the normality of data for this purpose of factorial analysis must exceed 100.

We present in table 2 the values of communality; this coefficient describes the covariance of the item with isolated factors, namely the extent to which each item has to do with the isolated factors (Almeida, Freire, 2007).

The fidelity was also evaluated through the evaluation of internal consistency, determined by the Cronbach's alpha coefficient (Streiner, Norman, 2008).

For the psychometric analysis of the scale we also evaluated the correlation between items (Pearson test), as well as factorial analysis confirmatory and exploratory.

To determine the effect of each variable in the internal consistency of the factor, we examined the Cronbach's Alpha if the item was eliminated, compared with the global alpha. We assumed that if the global alpha was significantly reduced with the removal of an item, it meant that internal consistency largely depend on this item and therefore it was not eliminated, as proposed by Pestana and Gageiro (2005).

On the other hand, we decided to remove the items whose removal would lead to increased alpha were removed, considering that this variable would have a weak correlation with the other (Pestana & Gageiro, 2005).

After we received authorization from the Governing Board of the Regional Center for Health Administration (authorization nº32543), and having obtained approval from the Ethics Committee for Health, we contacted directly local Managers of each data collection point. Then nurses' participation was requested and we explained them the purpose of the study.

It was mentioned that all information would be confidential and that they could stop their collaboration when they wished. We also provided all the necessary attention regarding the clarification of doubts and questions, according to the Declaration of Helsinki.

The statistical treatment of the data was performed using the SPSS (Statistical Package for Social Sciences), version 21.0. We used techniques of descriptive analysis, namely: measures of central

tendency (mode, median and mean) and variability measures of dispersion (standard deviation) and factor analysis procedures.

3. Results

We had a sample of 104 nurses, with an average age of 41.3 years (SD = 8.1), with maximum age of 62 years and a minimum of 29 years.

For the construction of the scale we did a first qualitative study aiming at identifying guidelines based in primary studies. This resulted in the identification of 4 guidelines (table 1), through which emerged the relevant variables for the evaluation of therapeutic education.

Table 1: *Guidelines Selected for Extraction of the Relevant Variables in Therapeutic Education*

Title Guideline				
	Year	***Country***	***Entity responsible for the guideline***	***Electronic page***
Type 2 diabetes - The management of type 2 diabetes	2008	United Kingdom	National Institute for Health and Clinical Excellence (NICE)	http://www.nice.org.uk/nicemedia/pdf/CG66NICEGuideline.pdf
Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada	2008	Canada	Canadian Diabetes Association	http://www.diabetes.ca/files/cpg2008/cpg-2008.pdf
Guidelines for the Practice of Diabetes Education - AADE Guidelines for the Practice of Diabetes Self-Management Education and Training (DSME/T)	2011	USA	American Association of Diabetes Educators (AADE)	http://www.diabeteseducator.org/export/sites/aade/_resources/pdf/general/PracticeGuidelines2011.pdf
National Evidence Based Guideline for Patient Education in Type 2 Diabetes	2009	Australia	National Institute for Health and Clinical Excellence (NICE)	http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/di16_diabetes_patient_education.pdf

As for the socio-economic and professional characteristics, these nurses were in the profession for an average of 17.7 years (SD = 7.8), with the minimum experience of 3 and maximum 40 years. They has a professional experience in diabetes area of 12.4 years on average (SD = 7.5), with a minimum of 1 year and a maximum of 40 years of experience.

Regarding the area of Diabetes and more precisely regarding the frequency of training in this area, after an early professional career, most respondents (60.6%) reported having attended such trainings while 39.4% reported not having attended any training in this area since they started working as a nurse.

3.1 Reliability of DEP Scale

The instrument presented in the various dimensions, with alpha values between 0.6720 and 0.834 (table 2), reveals reasonable internal consistency (Pestana & Gageiro, 2005).

We identified a corrected correlation of each item with the global dimension between 0.476 and 0.740, wich reveals a moderate correlation (Pestana & Gageiro, 2005), so according to Streiner and Norman (2008), no item was eliminated.

As to the effect of each variable on the internal consistency, which is indicated by the Alpha if the item is removed, we found that item number 5 showed slightly higher alpha values than global Alpha, so we considered it as essential to construct under analysis. Because global alpha did not improve with its exclusion, we decided to keep this item.

Table 2: *Pearson correlation and cronbach's alpha if item is deleted of DEP scale*

	Item	***r without the item***	***a without the item***
Data Collection			
1.	Data collection carried out systematically and as often as considered necessary for the user	,614	,798
2.	Data collection carried out systematically and as often as considered necessary for family members	,740	,764
3.	Data collection carried out systematically and as often as considered necessary for members of the social support network	,670	,780
4.	Data collection carried out systematically and as often as considered necessary to existing medical records	,629	,793
5.	Data collection carried out systematically and as often as considered necessary for reference health professionals	,505	,834
		Total Alfa	,828
Evaluation			
10.	Objective assessment in relation to self-care behavior at the beginning of the therapeutic process	,715	-
11.	Objective assessment of the results for the self-care behavior at regular intervals.	,715	-

		Total Alfa	,833
Patient centered Care			
7.	Establishment of therapeutic plan with the user	,561	,694
8.	Development of therapeutic education is structured following a curriculum/predefined plan	,476	,748
17.	Developing and implementing different strategies depending on the level of education / demonstrated ability	,599	,670
18.	Education is carried out based on the evaluation of identified needs and problems	,591	,680
		Total Alfa	,755
Continuity of care			
21.	Continued support with the frequency deemed necessary by the user	,507	-
22.	Support person caregiver / family for the acquisition and development of skills in the diabetes area	,507	-
		Total Alfa	,672

3.2 Validity of DEP Scale

To check whether each dimension consisted of one or more factors, we conducted factor analysis procedures of main components in all the subscales / dimensions. In order to maximize the saturation of items, we proceeded with the orthogonal Varimax rotation method.

After performing factor analysis for each dimension with more than 2 items, we found that the items in each dimension are grouped in only one factor.

From data presented in Table 3, it results KMO values from 0.803 and 0.647 (Bartlett $p < 0.001$) in the assessed dimensions, this reveals reasonable correlations between variables (Pestana & Gageiro, 2005).

Table 3: *Matrix of Principal Components after Varimax Rotation of Items of each Dimension of Multidimensional Scale DEP*

	Item	Principal components	Communalities
Data collection			
1.	Data collection carried out systematically and as often as considered necessary for the user	**,768**	**,589**
2.	Data collection carried out systematically and as often as considered necessary for family members	**,858**	**,736**
3.	Data collection carried out systematically and as often as considered necessary for members of the social support network	**,811**	**,657**
4.	Data collection carried out systematically and as often as considered necessary to existing medical records	**,778**	**,605**
5.	Data collection carried out systematically and as often as considered necessary for reference health professionals (ex.nutritionistas, podiatrists ...)	**,658**	**,433**
	% Explained variance	**60,412**	
	Kaiser-Meyer-Olkin (KMO)Test	**,803**	

	Bartlett's Test of Spheri city	**199,772; p< 0,0001**	
Evaluation			
10.	Objective assessment in relation to self-care behaviour at the beginning of the therapeutic process.	-	-
11.	Objective assessment of the results for the self-care behaviour at regular intervals.	-	-
	% Explained variance	**54,434**	
	Kaiser-Meyer-Olkin (KMO)Test	**,647**	
	Bartlett's Test of Sphericity	**129,614; p< ,0001**	
Continuity of care			
21.	Continued support with the frequency deemed necessary by the user	-	-
26.	Support person caregiver / family for the acquisition and development of skills in the diabetes area	-	-
	% Explained variance	-	
	Kaiser-Meyer-Olkin (KMO)Test	-	
	Bartlett's Test of Sphericity	-	

Regarding the convergent-discriminant validity of items, as we can see from Table 4, all items have a higher correlation with the factor which they belong to than the factor that they do not belong to.

Table 4: *Person Correlation among the Items with the Dimensions*

Items	Data Collection	Evaluation	Patient Cantered Care	Continuity of care
Data collection carried out systematically and as often as considered necessary for the user	,751**	,536**	,509**	,342**
Data collection carried out systematically and as often as considered necessary for family members	,839**	,551**	,500**	,506**
Data collection carried out systematically and as often as considered necessary for members of the social support network	,805**	,344**	,406**	,315**
Data collection carried out systematically and as often as considered necessary to existing medical records	,770**	,504**	,515**	,384**
Data collection carried out systematically and as often as considered necessary for reference health professionals (ex.nutricionistas, podiatrists ...)	,708**	,278**	,336**	,301**
Objective assessment in relation to self-care behavior at the beginning of the therapeutic process.	,462**	,920**	,552**	,443**
Objective assessment of the results for the self-care behavior at regular intervals.	,574**	,931**	,636**	,518**

Establishment of therapeutic plan with the user	,495**	,467**	,752**	,359**
Development of therapeutic education is structured following a curriculum/ predefined plan	,391**	,495**	,738**	,336**
Developing and implementing different strategies depending on th level of education / demonstrated ability	,468**	,451**	,793**	,519**
Education is carried out based on the evaluation of identified needs and problems	,421**	,551**	,768**	,657**
Continued support with the frequency deemed necessary by the user	,349**	,448**	,506**	,857**
Support person caregiver / family for the acquisition and development of skills in the diabetes area	,469**	,456**	,544**	,879**

This results indicate that the scale is valid.

4. Results Discussion and Conclusion

The scale have been built, tested and validated. From this process we found α values for the various dimensions close to 0.70-0.90. This result reveals a good/ reasonable internal consistency for each dimension. The correlation values between each item and the total scale revealed a moderate/high correlation (Pestana & Gageiro, 2005).

The scales have, given the data, reliable conditions.

Although we´ve not identified any scale that would allow evaluating the construct measured in the scale developed, the result indicates the accuracy of the scale. It seems safe to state that it can be applied in the future with a guarantee of consistent results (Coutinho, 2011).

The scale allows evaluating the developed interventions in therapeutic education to patient with diabetes. Considering the factor analysis, four dimensions have emerged, which were named: data collection, evaluation, patient-centered care and continuity of care.

The implementation of the nursing process in the field of therapeutic education for diabetic patients is reflected in the various items. The nursing process areas have been addressed as follows: data collection, diagnostic activity, goal setting, the intervention process and the evaluation of results.

For the dimensions of DEP Scale it results that the dimension with a lower α value is "Continuity of Care", which has only two items which relates to the continuous support to the person

and family. However, this value of 0.672 is close to the limit set by Pestana and Gageiro (2005), which considers that there is a reasonable internal consistency from the value of 0.7 for the value of α.

For Haggerty et al.(2003) the concept of Continuity of care in primary health care: (1) refers to the relationship between a care provider and the patient, going beyond isolated episodes of the disease, (2) involves a meaning of "membership" between the users and their carers associated with relational longitudinally, (3) relates for carers to the perception they have that the knowledge and necessary information about the user in order to intervene competently and the confidence that their care will be recognized and followed by other caregivers.

Considering the extent of the proposed definition, we can deduce that the two items of this dimension that resulted from validation procedures may be insufficient to cover the extensiveness of the construct to be measured.

For tested sample and for this dimension, there were some deleted items for presenting item correlation values with the total scale very low. We suggest future applications to be more extensive and with the inclusion of these items in order to assess the construct in a more complete and accurate way.

With the developed instrument DEP we propose for future research the assessment of interventions in self-care education in other countries, in order to compare different approaches. This instrument can be used in outcomes research in order to identify the most effective interventions.

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