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Original Article

Community Medicine Section

Validation of Malaysian Versions of Perceived Diabetes Self-Management Scale (PDSMS), Medication Understanding and Use Self-Efficacy Scale (MUSE) and 8-Morisky Medication Adherence Scale (MMAS-8) Using Partial Credit Rasch Model

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ABSTRACT

Introduction: The Diabetes Mellitus (DM) is a common silent epidemic disease with frequent morbidity and mortality. The psychological and psychosocial health factors are negatively influencing the glycaemic control in diabetic patients. Therefore, various questionnaires were developed to address the psychological and psychosocial well-being of the diabetic patients. Most of these questionnaires were first developed in English and then translated into different languages to make them useful for the local communities.

Aim: The main aim of this study was to translate and validate the Malaysian versions of Perceived Diabetes Self-Management Scale (PDSMS), Medication Understanding and Use Self-Efficacy Scale (MUSE), and to revalidate 8-Morisky Medication Adherence Scale (MMAS-8) by Partial Credit Rasch Model (Modern Test Theory).

Materials and Methods: Permission was obtained from respective authors to translate the English versions of PDSMS, MUSE and MMAS-8 into Malay language according to established standard international translation guidelines. In this cross-sectional study, 62 adult DM patients were recruited from Hospital Kuala Lumpur by purposive sampling method. The data were extracted from the self-administered questionnaires and entered manually in the Ministeps (Winsteps) software for Partial Credit Rasch Model. The item and person reliability, infit/outfit Z-Standard (ZSTD), infit/outfit Mean Square (MNSQ) and point measure correlation (PTMEA Corr) values were analysed for the reliability analyses and construct validation.

Results: The Malay version of PDSMS, MUSE and MMAS-8 found to be valid and reliable instrument for the Malaysian diabetic adults. The instrument showed good overall reliability value of 0.76 and 0.93 for item and person reliability, respectively. The values of infit/outfit ZSTD, infit/outfit MNSQ, and PTMEA Corr were also within the stipulated range of the Rasch Model proving the valid item constructs of the questionnaire.

Conclusion: The translated Malay version of PDSMS, MUSE and MMAS-8 was found to be a highly reliable and valid questionnaire by Partial Credit Model. The Malay version was conceptually equivalent to original version, easy to understand and can be used for the Malaysian adult diabetic patients for future studies.

Keywords: Reliability, Type 2 diabetes mellitus, Validity

INTRODUCTION

Diabetes Mellitus (DM) is one of the major source of increased morbidity, mortality and economic burden because of high prevalence and poor disease management. People with DM are at high risk for life threatening complications which would negatively affect the quality of life of the patients [1]. Diabetes is a progressive condition initially characterized by insulin resistance, where muscle and fatty tissue become relatively non-responsive to the effects of insulin. With the advancement of the disease, decreased beta cell activity results into abnormal high blood glucose levels above normal range [2].

Type 2 DM is the most common form of diabetes and is characterized by disorders of insulin action and insulin secretion, either of which may be the predominant feature. Both characters are usually present at the time of clinical manifestations of DM. By definition, the underlined reasons of these abnormalities are not yet known [3]. DM may harm other organs and body systems if not well treated or untreated and may lead to dangerous complications such as neuropathy (nervous system damage), nephropathy (renal system damage) and retinopathy (eye damage); these are microvascular complications. The macrovascular complications include cardiovascular disease, peripheral vascular disease and stroke [4]. Peripheral vascular disease can lead to trauma or wound that do not heal, gangrene and finally amputation [5].

According to the global psychosocial study on diabetes care; the Diabetes Attitudes, Wishes and Needs (DAWN) programme, the majority of patients with diabetes suffer from psychological problems. About 67.9% of type 1 diabetes patients and 65.6% of type 2 diabetes patients experience the psychological problems. Furthermore, DM patients with poor glycaemic control have a higher occurrence of psychological problems than patients with good glycaemic control [6].

Diabetes is a major factor of early death because of strong association with co-morbidities especially coronary heart diseases [7]. Cardiovascular disease causes up to 65% of all deaths in diabetes patients, ischemic heart disease and stroke account for the highest proportion of morbidity associated with diabetes [5].

The Malaysian National Health Morbidity Survey (NHMS) (2006)

reported that 4.3% of DM patients had lower limb amputation, 3.4% had stroke and 1.6% had kidney end stage failure in Malaysia [8]. Similarly, other studies also indicated the high prevalence of these complications in diabetic patients [9-12].

In order to achieve glycaemic control and prevent complications, DM patients should be capable and responsible for performing diabetes self-care management [13]. Various questionnaires were developed to address the psychological and psychosocial well-being of the diabetic patients [14]. Most of these questionnaires were first developed in English and then translated into different languages to make them useful for the local communities. The main aim of this study was to translate and validate the Malaysian versions of Perceived Diabetes Self-Management Scale (PDSMS), Medication Understanding and Use Self-Efficacy Scale (MUSE), and to revalidate 8-Morisky Medication Adherence Scale (MMAS-8) by Partial Credit Rasch Model (Modern Test Theory).

MATERIALS AND METHODS

1. Participants and Setting

Prior to the enrollment of diabetes patients, ethics approval was obtained from the Research Management Institute (RMI), Universiti Teknologi MARA (UiTM), Shah Alam and the Medical Review and Ethics Committee (MREC), Ministry of Health (MOH) via the National Medical Research Registry (NMRR). This study was conducted from July to September, 2014. Post-consent, 62 adult diabetic patients (aged ≥18-year-old, diagnosed as either type 1 or type 2 diabetes and able to understand Malay) attending diabetes (endocrine) clinic at Hospital Kuala Lumpur was recruited.

Study Instrument (Questionnaire)

The study instrument was divided into four parts as following:

Part A: In first part of the questionnaire, the socio-demographic and medical data of the enrolled diabetic patients were recorded.

Part B: This part consisted of 8 items and was adapted from Wallaston and co-workers to assess the perceived self-management of the enrolled diabetic patients [15]. It was a balanced scale with the same number of positively and negatively worded items which was not available in other scales, with a well-reported Cronbach's alpha of 0.83. The responses were recorded on a 5-point Likert scale and it ranged from *Strongly Disagree* (score=1) to *Strongly Agree* (score=5). Four of the items (item number: 1, 2, 6, and 7) were negatively worded. These four items were reverse-scored. The total of PDSMS score can range from 8 to 40, with higher score indicating more confidence in self-managing one's diabetes.

Part C: It consisted of two subscales which were taking medication (n = 4 items) and learning about medication (n = 4 items). Response to each items were scored on a four point Likert scale (strongly disagree, score=1 to strongly agree, score=4). The range of the total score may vary from 4 to 32 [16].

Part D: In this part, medication adherence in diabetic patients was assessed using MMAS-8 [17]. Each item measured a specific behaviour with response choices of either yes or no for items 1 to 7, and the last item was measured by a 5-point Likert scale. Each response was scored 0 and 1 for no and yes response, respectively. The total score ranged from 0 to 8. A total score of 8 items was categorized as low adherence (score < 6 points), medium adherence (score, 6 to 7 points), and high adherence (8 points) [16].

This study was divided into two steps. In first step translation and qualitative validation of instrument were completed, while in second step qualitative validation was done by extracting data from the completed instruments from the respondents.

Questionnaire Translation

Permission to translate the English questionnaires of PDSMS and MUSE to Malay language was obtained from the respective authors and finalized questionnaire was translated according to the international standard translation guideline [18].

Forward and backward translation: The original questionnaire was translated from English to Bahasa Malaysia by two independent local professional bilingual experts; one of them had clinical background and the other was linguistic expert. Both translated versions were reviewed by the local project manager of translation committee and agreed on a single reconciled version (reconciliation). In backward translation, the reconciled translated questionnaire was back-translated from Bahasa Malaysia to English language by other local independent professional translators who were totally blind to the original version.

Harmonization: Prior to administering translated questionnaire, translation committee that reviewed those forward and backward translations checked and modified format, modified or rejected inappropriate items/words for final consensus. Any content value variances among the translations in this targeted language were identified and resolved for uniformity of translations. The local project manager of translation committee together with another independent endocrinologist (since instrument is a disease-specific) reviewed and approved the second harmonized translation for cognitive debriefing interviews.

Testing for Translated Questionnaire: The translated questionnaires were distributed to respondents who were not a part of the targeted sample of this study. Each subject completed the questionnaire and interviewed about the meaning of each item, instruction and response choice and asked if there were any difficulties in understanding those cognitive debriefing interviews. The questionnaires were adapted according to Malaysian culture especially in the demographic part such as ethnic groups, seasons in the years, education system and health insurance system. Because the researcher faced some patients' confusion about some items, it was decided that several actions must be taken, including a meeting between researchers, translation committee and a consultation with an expert translator. These actions helped to solve those obstacles and selected the most suitable expressions for the confusing items.

Proofreading and Finalization: The final version for both translated versions were discussed, checked, amended and proofread by a native Bahasa Malaysia speaking group to perform a final check of the spelling, grammar, and page layout. After this step the final version for both M-PDSMS and M-MUSE in addition to M-MMAS-8 were ready to be distributed to the real sample of respondents.

STATISTICAL ANALYSIS

The demographic profiles of the participants were described using mean (±SD) and range for continuous variables, while frequency and percentage for categorical variables.

The face or content validity was performed by asking the respondents if they understand the questions and also by sending the translated questionnaire to two experts. Their comments were used to improve the items in the translated questionnaire. The researchers have used Ministeps (Winsteps) software based on Rasch-Model analysis to measure the construct validity, person and item reliability for the Malaysian versions of PDSMS, MUSE and MMAS-8.

Rasch-Model Overview

The Rasch-Model has been increasingly used in health field and explores the performance of each item [19]. In general, to develop or translate an instrument, we should examine if a set of items in

the instrument measure the target construct consistently (validity and reliability). The present study used Modern Test Theory (MTT) or Item Response Theory (IRT) approach by applying parameters of Partial Credit for Rasch analysis. The parameters of the model analysed persons and items responses as the graded responses. This "Partial Credit" model provides the opportunity to estimate item parameters independently of the characteristic of the calibrating sample, and to free person measures from the particulars of the items taken [20]. This model has several appealing properties which compare favourably with the properties of other latent trait models for polytomous data [21]. It maximizes a likelihood function that is conditional upon sufficient statistics for one set of parameters.

In view to its approach with several theoretical and practical advantages [22], present study chose to recode partial credit items by collapsing categories in order to improve measurement effectiveness and to increase parameter stability. The analysis of partial credit data to situations in which response alternatives are free to vary in number and structure from item to item [23,24].

In present study, Rasch model was used to determine the relation of the difficulty of an item (in PDSMS, MUSE and MMAS-8) to the ability of a person to answer these items, high ability of a person has high probability to answer the item [25]. It provides two parameter estimates: person position and item difficulty. Rasch introduced the analysis system with ratio-based values, rather than average score of number values and this model provides results using log odd unit or logit scale. Therefore, it is considered better and more accurate model for analysing ordinal raw data which is not available in Classical Test Theory (CTT).

Rasch model can be applied wherever data are obtained even by Likert scale. The performance of each item is analysed by various parameters of the model, where each parameter is reviewed against the Rasch specifications [26]. MNSQ is a chi-squared statistic divided by its degrees of freedom. The MNSQ values substantially less than 1.0 indicate overfit (dependency in data), whereas, the values substantially greater than 1.0 indicate underfit (unmodeled noise). Moreover, ZSTD is used as a t-test result when either the t-test value has effectively infinite degrees of freedom. PTMEA Corr is computed by the Pearson point-measure correlation coefficients between the observations and the measures, estimated from the raw scores including the current observation or the anchored values. Furthermore, MODEL RMSE (best case reliability) is computed on the basis that the data fit the model, and that all misfit in the data is merely a reflection of the stochastic nature of the model, it describes an upper limit to the reliability of measures based on this set of items. Moreover, the REAL RMSE (worst case reliability) is computed on the basis that misfit in the data is due to departures in the data from model specifications, it reports a lower limit to the reliability of measures based on this set of items for this sample [27].

For well-constructed tests with clean data, the model standard error is usefully close to, but slightly smaller than the actual standard error. Therefore, the actual SE lies between the "model" and "real" values. The values should be ranged between 0.4 and 0.8 for PTMEA Corr; 0.5 and 2 for infit/outfit MNSQ; and -2 and +2 for ZSTD. The items fulfil these criteria are considered as well fitted to the model, in other words, valid [28].

RESULTS

1. Sample characteristics

In present study, 62 adult diabetic patients were enrolled. The mean age of the patients was 47.01 (±4.68) years old. Majority of the patients were Malay (n=47, 75.80%), and suffering from diabetes mellitus type 2 (n=42, 67.7). The details of socio-demographic data and medical data are shown in [Table/Fig-1].

2. Person and item reliability

For person and item reliability, output table found 1488 data points. The results showed the good person reliability (α = 0.76) with separation of 1.77; and excellent item reliability was excellent (α = 0.93) with items separation of 3.58. Both values surpassed the good reliability index of 0.70 as shown in [Table/Fig-2].

Sr.	Items	Category	Mean (±SD)	n (%)
1	**Age (years old)**		47.01 (±4.68)	
2	**Gender**	Male		29 (46.8)
		Female		33 (53.2)
3	**Ethnicity**	Malay		47 (75.8)
		Chinese		0 (0)
		Indian		13 (21.0)
		Others		2 (3.2)
4	**Marital status**	Single		11 (17.7)
		Married		43 (69.4)
		Widow		2 (3.2)
		Divorced		6 (9.7)
5	**Education level**	Primary school		5 (8.1)
		Secondary school		28 (45.2)
		College		14 (22.6)
		University		14 (22.6)
		Others		1 (1.6)
6	**DM-duration (year)**		12.11±8.63	
7	**Administration medicine**	Oral		4 (6.5)
		Insulin		17 (27.4)
		Oral antihyperglycaemicand insulin		41 (66.1)
8	**No. of medication taking**	One		6 (9.7)
		Two		27 (43.5)
		More than two		29 (46.8)
9	**HBA1C %**		9.28 (±2.17)	

[Table/Fig-1]: Socio-demographic and medical profile of patients (n = 62).

Summary of 62 Measured Person								
	Total Score	Count	Measure	Model Error	Infit		Outfit	
					MNSQ	ZSTD	MNSQ	ZSTD
Mean	61.7	24.0	0.97	0.34	1.07	0.0	1.03	0.0
S.D.	±7.2	±0.0	±0.81	±.04	±0.65	±1.5	±0.46	±1.2
Max.	75.0	24.0	2.88	0.46	4.43	4.7	2.27	2.3
Min.	38.0	24.0	-1.28	0.29	0.30	–2.8	0.34	-2.7
Real RMSE .40		True SD .70		Separation 1.77		Person Reliability .76		
Model RMSE .35		True SD .73		Separation 2.11		Person Reliability .82		
S.E. of Person MEAN = .10								
Summary of 24 Measured Item								
	Total Score	Count	Measure	Model Error	Infit		Outfit	
					MNSQ	ZSTD	MNSQ	ZSTD
Mean	159.4	62.0	0.00	0.24	0.99	-0.1	1.03	0.0
S.D.	±78.9	±0.0	±0.98	±0.09	±0.32	±1.5	±0.38	±1.7
Max.	251.0	62.0	2.03	0.48	2.24	5.3	2.40	5.9
Min.	23.0	62.0	-1.72	0.15	0.58	-2.4	0.55	-2.3
Real RMSE .26		True SD .95		Separation 3.58		Item Reliability .93		
Model RMSE .26		True SD .95		Separation 3.70		Item Reliability .93		
S.E. of item mean = .21								

[Table/Fig-2]: Item and Person's Reliability for (PDSMS, MUSE and MMA-8) Partial Credit Model.
1488 Data Points. Log-Likelihood Chi-Square: 2320.57

Entry Number	Total Score	Total Count	Measure	Model S.E.	Infit		Outfit		Ptmeasure-A		Exact Match		G
					MNSQ	ZSTD	MNSQ	ZSTD	Corr.	Exp.	OBS%	Exp%	
1	189	62	0.78	0.15	1.02	0.2	1.06	0.4	0.55	0.56	37.1	42.2	0
2	201	62	0.69	0.15	1.00	0.1	1.01	0.1	0.56	0.55	41.9	43.0	0
3	251	62	-0.23	0.19	1.17	0.8	1.31	1.4	0.33	0.48	62.9	59.3	0
4	232	62	0.10	0.18	1.02	0.2	1.03	0.2	0.51	0.50	58.1	57.2	0
5	209	62	1.11	0.20	1.00	0.1	0.96	-.1	0.45	0.46	61.3	56.4	0
6	199	62	0.60	0.16	1.29	1.7	1.48	2.6	0.33	0.53	46.8	44.7	0
7	191	62	1.92	0.17	1.01	0.1	1.06	0.4	0.50	0.51	41.9	43.1	0
8	232	62	0.61	0.23	0.99	0.0	1.04	0.3	0.44	0.42	69.4	64.8	0
9	211	62	-0.26	0.19	0.76	-1.0	0.76	-1.0	0.64	0.47	71.0	58.5	0
10	216	62	-0.72	0.23	0.69	-1.5	0.65	-1.9	0.66	0.41	77.4	62.2	0
11	219	62	-0.77	0.23	0.68	-1.5	0.67	-1.6	0.66	0.41	77.4	63.7	0
12	224	62	-0.86	0.25	0.75	-1.5	0.67	-1.7	0.64	0.38	85.5	67.0	0
13	218	62	-1.07	0.26	0.80	-1.6	0.76	-1.8	0.60	0.37	79.0	64.0	0
14	209	62	0.11	0.20	0.74	-1.7	0.70	-1.8	0.65	0.45	59.7	54.2	0
15	214	62	-0.69	0.20	0.58	-2.4	0.55	-2.3	0.73	0.45	74.2	60.0	0
16	213	62	-0.31	0.18	0.69	-1.5	0.63	-1.5	0.67	0.49	67.7	59.1	0
17	23	62	1.57	0.28	1.09	0.8	1.04	0.3	0.26	0.34	62.9	67.6	0
18	44	62	-0.04	0.30	1.02	0.2	1.10	0.5	0.28	0.33	74.2	72.6	0
19	55	62	-1.32	0.42	1.13	0.5	1.43	1.0	0.03	0.24	88.7	88.7	0
20	45	62	-0.13	0.30	0.96	-0.2	0.93	-0.2	0.36	0.32	75.8	73.9	0
21	57	62	-1.72	0.48	1.11	0.4	1.07	0.3	0.09	0.21	91.9	91.9	0
22	54	62	-1.16	0.39	0.96	-0.1	1.38	1.0	0.22	0.25	88.7	87.2	0
23	46	62	-0.22	0.31	0.98	-0.1	0.96	-0.1	0.34	0.32	75.8	75.3	0
24	74	62	2.03	0.16	2.24	5.3	2.40	5.9	-0.25	0.54	25.8	44.4	0
Mean	159.4	62.0	0.00	0.24	0.99	-0.1	1.03	0.0			66.5	62.5	
S.D.	±78.9	±0.0	±0.98	±0.09	±0.32	±1.5	±0.38	±1.7			±17.1	±13.9	

[Table/Fig-3]: Partial Credit Model for 24 Items of (PDSMS, MUSE and MMAS-8).

3. Validity for the Translated Questionnaires (PDSMS, MUSE and MMAS-8)

This current pilot study shows that all items measure for the three scales questionnaires (PDSMS, MUSE and MMAS-8) are fitted to Rasch-Model except the last item in MMAS-8 that was just slightly out of range. For MMAS-8, the mixture of two different types of scales where item 1–7 is dichotomous and item 8 is polytomous (5-likert scale). All items were fitted and correlated except few items (1, 2, 3, 5, and 6) that were slightly outside of ideal range of correlation. However, these items still have acceptable correlation and considered as valid, providing the empirical evidence that the items measure the construct of interest as shown in [Table/Fig-3].

DISCUSSION

The purpose of this preliminary study was to assess the psychometric properties of the Malaysian versions for PDSMS, MUSE and MMAS-8 for adult diabetes mellitus patients by Rasch Model. The translated Malay version was found to be conceptually equivalent to the original English version [15-17], easy to understand by the patients, and acceptable in term of internal consistency. The implemented international standard translation procedure ensured that the translated versions were culturally adapted to Malaysian community [18].

The original versions of PDSMS, MUSE and MMAS-8 are already established in the literature as valid and reliable tools from traditional psychometric analyses including internal consistency, short-term test-retest and validity [15-17]. However, this present study used modern psychometric perspectives to assess the reliability and validity for the translated versions.

According to the results of item measure, all items of the scales questionnaires were confirmed by Rasch-Model as well and fitted the model. The Malaysian versions of the PDSMS, MUSE and MMAS-8 proved to have excellent internal consistency, which is higher than the minimum recommended value (0.70) [21].

In view to unique multicultural ethnicities in Malaysia, the present study suggested to translate and validate these study questionnaires to Mandarin and Tamil languages to widen distribution of respective questionnaires especially among those patients who are not fluent in Bahasa Malaysia in order to produce more holistic data in determining perceived diabetes self-management, self-efficacy in understanding and using diabetes medications, and diabetes medication adherence among Malaysian DM patients. In Malaysian healthcare system, pharmacist-led medication therapy adherence clinics (MTACs) are introduced in order to improve medication adherence in chronically ill patients. The translated questionnaires can be administered to the patients at the time of their visit to the diabetes MTAC (D-MTAC). This will help the pharmacist to device the individualised patient-centred counselling and education plan.

CONCLUSION

The translated Malaysian versions of PDSMS, MUSE and MMAS-8 were found to be a highly reliable and valid instrument by Partial Credit Rasch measurement Model. Therefore, for future clinical practice and research, these cultural adapted Malaysian versions that were easy to understand and conceptually equivalent to the original English versions, can be used to address these respective three psychosocial issues among Malaysian adult DM patients in controlling and monitoring their DM status including blood glucose and arising of related complications.

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