British Journal of Medicine & Medical Research
9(9): 1-10, 2015, Article no.BJMMR.17345
ISSN: 2231-0614

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Psychometric Properties of the Persian Version of the Morisky Medication Adherence Scale-8

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Authors' contributions

This work was carried out in collaboration between all authors. Author MD designed the study, wrote the protocol, managed the literature searches, performed the statistical analysis and wrote the first draft of the manuscript. Author NDN provided advice for the study design and supervised writing the manuscript. Author PK wrote the protocol and gathered the data. Author SI provided advice for the study design and supervised writing the manuscript. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/BJMMR/2015/17345
Editor(s):
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Complete Peer review History: http://sciencedomain.org/review-history/10183

Original Research Article

Received 9th March 2015
Accepted 15th June 2015
Published 14th July 2015

ABSTRACT

Background: Hypertension is a global public health crisis. Poorly controlled high blood pressure is one of the most important factors contributed to this crisis. Lack of medication adherence is often considered as the main reason for insufficient control of high blood pressure. Difficulty in measuring medication adherence is another problem in this field. To reduce this difficulty several medication adherence scales were developed. This study was performed to test reliability and

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validity of Morisky Medication Adherence Scale-8.
Materials and Methods: A cross-sectional study was conducted to validate the Persian version of MMAS-8. The Persian version of MMAS-8 was generated by using a modified forward/backward translation procedure. Two hundred and fifty hypertensive patients were participated in the study. Construct and known-groups validity, Cronbach's alpha and test-retest reliability were used to assess psychometric properties of Persian scale.
Results: Data analysis showed that the scale did not have an acceptable internal consistency (Cronbach's Alpha= 0.40) but had excellent stability (ρ = 0.89). The confirmatory factor analysis poorly fitted with one-dimensional model. Participants with controlled blood pressure had significantly higher MMAS-8 scores than uncontrolled blood pressure group.
Conclusion: Totally some of the psychometric properties of the Persian version of the MMAS-8 did not meet the requirements of the standard level so it is not recommended to use in general. More studies are needed to establish a more appropriate scale in order to be used in the mentioned population.

Keywords: Medication adherence; hypertension; morisky scale; psychometric properties.

1. INTRODUCTION

High blood pressure is one of the most common causes of cardiovascular, cerebrovascular, renal diseases or other end organ damage leading to premature death [1-3]. According to the World Health Organization (WHO), approximately 75% of hypertensive patients are not sufficiently controlled. As they reported, one of the main reasons for this failure is low medication adherence so that more than half of the patients treated for hypertension do not adhere to their recommended medication regimen [4]. Non-adherence to medication regimen may worsen the disease, increasing morbidity and mortality, frequent hospitalization, and significant healthcare costs [5,6].

In order to understand adherence, the first step is to measure patient adherence to prescribed medication regimen. Several methods are used to assess medication adherence including drug levels in plasma, Medication-Events monitoring systems that electronically record every opening of a pillbox and treatment outcomes. However, these measures are expensive and impractical for clinical practice [5,7-9]. Therefore, patients self-report is the most cost effective and practical way to estimate the patient's adherence to the prescribed medication regimen [8,9]. Different medication-adherence scales have been designed in various settings to assess patient-reported compliance levels [10-12]. The Medication Adherence Scale (MAS), The Hill-Bone Compliance Scale, the Self-efficacy for Appropriate Medication Use Scale (SEAMS), the Brief Medication Questionnaire (BMQ), the 10-item Medication Adherence Rating Scale (MARS) and the Medication Adherence Reason Scale (MAR-Scale) are some of the most usable scales to assess treatment adherence [13-20]. Each scale has specific strengths and limitations. According to Lavsa et al. [5] "MAQ is the shortest scale and identifies barriers to non-adherence but not self-efficacy. The SEAMS and the BMQ both assess barriers and self-efficacy; however, scoring is difficult. The Hill-Bone Compliance Scale and the MARS address barriers and self-efficacy but are limited in their generalizability". In addition, some of these scales (the MAQ, SEAMS, BMQ and MAR-scale) are more general and have been used in different therapeutic fields, e.g., hypertension, dyslipidemia, asthma, cholesterol lowering medication and diabetes [5,19,20], while the others (MARS and the Hill-Bone Compliance Scale) focus on specific populations [15,18]. Therefore, the MAS is the shortest scale and identifies barriers to non-adherence. In addition it is easy for scoring and has been used in different therapeutic fields including; hypertension, dyslipidemia, and diabetes [5]. Morisky et al. [13,14] developed the Medication Adherence Scale (MAS) in 1986 and revised it in 2008. The first version of the MAS consisted of four items, and the revised form consists of eight items. The revised form of MAS (MMAS-8) has four additional items addressing the circumstances surrounding adherence behavior. The psychometric properties of the MMAS-8 have been evaluated in different countries, including the United States, France, Korea, Pakistan, Malaysia, Thailand and Brazil. Most of the studies had reported moderate to good internal consistency, repeatability and acceptable validity [21-28].

In Iran, the prevalence of hypertension is estimated by 23% in 30-55 aged population and

by 50% in population older than 55 years old [29]. Javadi et al. [30] showed that only 5% of Iranian hypertensive patients comply with their prescribed regimen and have controlled blood pressure. In Iran, medication adherence was mostly measured by using researcher-designed questionnaires. The validating process of developing these questionnaires was not sufficient [31,32]. Iran is a large country with a population of about 76 million and it is located in southwest Asia and the Middle East. People of different ethnicities are living in Iran including: Turkish in the northwest, Kurdish in the west, Arab in the south and southwest, Fars in the center, Turkmen in the northeast, and Baluch in the east. Each ethnicity has different culture, lifestyle, and socioeconomic status, which might cause variations in the adherence to the anti-hypertensive treatment regimen. Kerman is the largest province in the southeast of Iran. The geographical location of this Province results in hospitalization of people of different ethnicities in the cardiovascular departments of the educational hospitals in the Province especially those of Arab ethnicity in the south, Fars in the center, and Baluch in the east [33]. The aim of the study was to assess the validity and the reliability of the Persian Morisky Medication Adherence Scale (MMAS-8) among Iranian Hypertensive patients.

2. MATERIALS AND METHODS

2.1 Study Design and Setting

This was a cross-sectional study conducted in the cardiovascular departments of teaching hospitals affiliated with the Kerman University of Medical Sciences in 2014.

2.2 Sampling

The convenience sampling technique was used to select hypertensive subjects. Before the data collection, the third researcher was trained by the first researcher in two sessions. He was well informed about the goal of study and the scale items. Also, the standard procedure of measuring blood pressures was reminded. The sampling was done in different work shifts (morning, afternoon and night) by the certified nurse. According to Comrey [34,35] (1988) the sample size of 200 is adequate in most cases of ordinary factor analysis including 40 items. In the present study to support the probable drop out of the samples we collected 250 subjects to validate the construct validity. In addition, we selected 25 subjects for reliability (repeatability). The sampling was lasted from November 2013 to January 2014.

2.3 The Morisky Medication Adherence Scale-8

The MMAS-8 is a generic assessment of medication-taking behaviour developed by Morisky et al. [13] (2008). This self-reported measure of medication taking was developed from a previously validated four-item scale. According to Morisky et al. [14] this scale is one dimensional scale. The Morisky Medication Adherence Scale comprises seven questions with a yes/no response format and one question with 5-point Likert response. The resulting score ranges from zero to 8 points. Categories of High (8 points), medium (6 to <8 points), and low adherences (<6 points) have been previously defined to facilitate their usage in clinical practice [23].

2.4 Translation

We used a modified forward/backward translation procedure to generate the Persian version of MMAS-8 [36,37]. The original English version of the scale was translated into Persian by two experienced Iranian health experts independently. The translators and the research team discussed about forward translation version and made a consensus about that. Then this initial Persian version was back translated into English by two independent translators who had no previous knowledge about the scale. The backward translation was used to check the quality of the first translation. A bilingual expert panel checked the semantic and conceptual equivalences and resolved the discrepancies between the original and back-translated versions.

In the next step, 25 hypertensive patients with different level of education were selected to test the face validity of the Persian scale. Each patient was interviewed about the meaning of each item. In addition, they were asked to state their opinions on relevancy and difficulty of reading the scale' items. Based on the patients opinions, there were no irrlavant or ambiguous items. Therfore, the Persian version of the scale was confirmed.

2.5 Data Collection

Inclusion criteria to the study were patients of 18 years of age or older under treatment with at

least one anti-hypertensive medication. In addition, patients with essential hypertension and ischemic heart disease were included in the study and patients with renal complications or dialysis were excluded. Socio-demographic data such as age, gender, marital status, educational-occupational status, duration of hypertension, initiation of medication treatment, and number of prescribed medications were gathered. An aneroid sphygmomanometer (ALPK2, Japan) was used to measure blood pressures. This device was validated by comparing its results to those of a mercury sphygmomanometer. The certified nurse measured systolic and diastolic blood pressure from the right arm of the subject, while they were comfortable and in a seated position. Subjects were required to avoid caffeine intake, and they were advised not to smoke for 30 minutes prior to the blood pressure measurement. The average of two measurements taken five minutes apart was used for analysis. The blood pressure of≥140/90 mmHg (in diabetic patients≥130/80 mmHg), indicated insufficiently controlled hypertension and that of<140/90 mmHg (in diabetic patients<130/80mmHg), considered as sufficiently controlled hypertension [12,14]. The third researcher measured all blood pressures. Interviews were used for illiterate individuals instead of the self-administered method. In addition, data were collected for the second time in the test-retest reliability by using telephone contacts.

2.6 Ethical Consideration

The study followed the guidelines of the Declaration of Helsinki. This project was approved by Kerman University of Medical Sciences (KUMS). Subjects were provided comprehensive information about the goal and objectives of the study and the confidentiality of the data. In addition the participants were free to withdraw from the study at any time. Note that the informed consent was obtained verbally.

2.7 Statistical Analysis

All analyses were performed using SPSS version 17 (SPSS Inc., Chicago, Illinois, United States) and LISREL version 8.70 (Scientific Software International, Chicago, Illinois, United States). Descriptive (frequency and percentage, mean, and standard deviation) and analytical statistics (Spearman's rho coefficient, Mann-Whitney U test, and confirmatory factor analysis) were used to analyze the data. Note that the Mann-Whitney U test was used since the Kolmogorov-Smirnov test showed no normal distribution of data. The 0.05 significance level was used in this study. We use confirmatory factor analysis (CFA) to test the structural validity of Persian version of MMAS-8. The first-order CFA model was executed to evaluate the goodness-of-fit of the scale that was a one-factor model in previous studies [14,23]. The adequacy of the model was evaluated by the chi-squared test. Goodness-of-Fit Index (GFI), Adjusted Goodness-of-Fit Index (AGFI), Comparative Fit Index (CFI), Incremental Fit Index (IFI), Non-Normed Fit Index (NNFI), Root Mean Squared Error of Approximation (RMSEA), and the Standardized Root Mean Square Residual (SRMR) were the main indices used to determine the fit of the model. Acceptable fit of the model was indicated by χ^2/d.f.<3.0, RMSEA<0.08, and SRMR<0.05. The values of the GFI, AGFI, CFI, IFI, and NNFI indices were 0.9 or higher [38-40]. To evaluate known-groups validity, the difference of the P-MMAS-8 score between blood pressure groups (sufficiently controlled vs. insufficiently controlled) was calculated using the Mann-Whitney U test. The internal consistency was assessed in our study by Cronbach's α (should be>0.70) for 250 hypertensive patients. To evaluate the repeatability of the P-MMAS-8, the Spearman correlation coefficient was used to assess test-retest reliability at two-week intervals. To interpret the coefficients, we considered values above 0.7 as excellent reliability [41].

3. RESULTS

3.1 Socio-Demographic Characteristics

In total, 250 hypertensive patients were assessed. The mean age of participants was 55.94 ± 9.06 years. More than 65% of them were men. Nearly 70% were married who their partner were alive. The mean duration of Hypertension was 42.45 ± 28.09 months and the mean period of hypertension drug therapy was 40.81 ± 27.9 months. Nearly 86% of participants had insufficiently controlled blood pressure. According to the Persian Morisky Medication Adherence Scale (P-MMAS) the hypertensive medication adherence was 3.85±1.58. More than 90% of participants had low antihypertensive medication adherence (Table 1). The distribution of the responses to each item in the P-MMAS is presented in Table 2. More than 40% respondents reported adherence to only four items (items 1,2,3 and 7) (Table 2).

Table 1. Description of the study sample (n= 250)

Variables	Mean (SD)
Age (yr)	55.94 (9.06)
Duration of having hypertension (mo)	42.45 (28.09)
Duration of treatment for hypertension (mo)	40.81 (27.9)
P-MMAS* score	3.85 (1.58)
	Frequency (%)**
Sex	
Female	80 (32.0)
Male	170 (68.0)
Marital status	
Single	7 (2.8)
Married	181 (73.0)
Divorced	7 (2.8)
Widowed	53 (21.4)
Education status	
Illiterate	103 (41.5)
Under diploma	71 (28.6)
Diploma	48 (19.4)
Bachelor's degree	26 (10.5)
Above bachelor's degree	-
Occupation	
Unemployed	45 (18.1)
Employed	133 (53.3)
Pensioner	37 (14.9)
Housewife	34 (13.7)
Having diabetes	
Yes	64 (25.6)
No	186 (74/4)
Number of prescribed medications	
One medicine	124 (49.6)
More than one medicine	126 (50.4)
Blood pressure control	
Controlled	35 (14.0)
Uncontrolled	215 (86.0)
P-MMAS level of adherence	
Low adherence (< 6)	234 (93.6)
Medium adherence (6 to < 8)	16 (6.4)
High adherence (8)	-

** The Persian Morisky Medication Adherence Scale, ** Valid percent*

3.2 Construct Validity

According to the first-order CFA model, the loadings of items were statistically significant at the 0.05 level (t values > 1.96) except for items 5 and 7. The χ^2-associated P value was below the 0.05 significance level (χ^2 =83.24, d.f. = 20, and P <0.001). One of fit indices reached acceptable levels (χ^2/d.f. = 4.16, RMSEA = 0.11, SRMR = 0.08, **GFI = 0.92**, AGFI = 0.86, CFI = 0.71, IFI = 0.72, and NNFI = 0.59). Consequently, based on the fit indices, the model provided a poor fit to the data.

3.3 Known-groups Validity

The mean score of P-MMAS was 4.57 ± 1.83 and 3.73 ± 1.51 among patients with sufficiently controlled blood and among patients with insufficiently controlled blood pressure respectively. The mean score of the P-MMAS was significantly higher in sufficiently vs. insufficiently controlled group (Mann-Whitney U test= 8.82, P value = 0.003).

3.4 Reliability

The value of Cronbach's α for the P-MMAS was 0.40. The P-MMAS item-total correlations ranged from -0.1 (Item 5) to 0.45 (Item 2). The test-retest reliability coefficient of the P-MMAS was 0.89 indicating excellent reliability at a two-weak interval (Table 3).

4. DISCUSSION

According to the results, ''the Persian Morisky Medication Adherence Scale-8'' had not sufficient psychometric quality in different aspects of construct validity and internal consistency. However the P-MMAS-8 had excellent repeatability and acceptable known-groups validity.

In Table 4, results of several studies [14, 21-28] are presented to compare our study's reliability, construct validity, known group validity, sensitivity and specificity. As presented in Table 4, the confirmatory factor analysis poorly fitted with the proposed underlying latent constructs (one single model). Our finding was confirmed with some of previous studies [23-28]. Like the study of Korb-Savoldelli et al. [22], item 5 had a low factor loading. Korb-Savoldelli argued that this was probably due to a recall bias because the item is about patient medication taken the day before. However this reason could not be logic. In our study, the fact that the respondents do not report the use of medication the day before, is probably due to the fear of judgment that researchers will make their case say that the patient did not take the medication yesterday.

Table 2. Distribution of the responses to the Persian Morisky Medication Adherence Scale

Questions	Response, n (%*)				
	Yes			No	
1. Do you sometimes forget to take your hypertension pills?	133 (53.2)			117 (46.8)	
2. People sometimes miss taking their medications for reasons other than forgetting. Thinking over the past two weeks, were there any days when you did not take your hypertension medicine?	135 (54.0)			115 (46.0)	
3. Have you ever cut back or stopped taking your medication without telling your doctor, because you felt worse when you took it?	87 (34.8)			163 (65.2)	
4. When you travel or leave home, do you sometimes forget to bring along your hypertension medication?	188 (75.2)			62 (24.8)	
5. Did you take your hypertension medicine yesterday?	190 (76.0)			60 (24.0)	
6. When you feel like your hypertension is under control, do you sometimes stop taking your medicine?	181 (72.4)			69 (27.6)	
7. Taking medication everyday is a real inconvenience for some people. Do you ever feel hassled about sticking to your hypertension treatment plan?	134 (53.6)			116 (46.4)	
8. How often do you have difficulty remembering to take all your medications?	Never 28 (11.2)	Once in a while 30 (12.0)	somthmes 109 (43.8)	usually 57 (22.9)	All the time 25 (10.0)

Table 3. The Persian Morisky Medication Adherence Scale (MMAS-8-Item) reliability

Questions	Corrected Item-to-total correlation (n=30)	Cronbach's alpha if item deleted	Spearman rho coefficient/P value (n = 25)	Wilcoxcon/ P value
1. Do you sometimes forget to take your hypertension pills?	0.45	0.21	0.84 (< 0.001)	Z = 0.00 (>0.99)
2. People sometimes miss taking their medications for reasons other than forgetting. Thinking over the past two weeks, were there any days when you did not take your hypertension medicine?	0.45	0.21	0.83 (< 0.001)	Z = 0.00 (>0.99)
3. Have you ever cut back or stopped taking your medication without telling your doctor, because you felt worse when you took it?	0.17	0.37	1 (< 0.001)	Z = 0.00 (>0.99)
4. When you travel or leave home, do you sometimes forget to bring along your hypertension medication?	0.002	0.44	0.69 (< 0.001)	Z = -1 (0.34)
5. Did you take your hypertension medicine yesterday?	- 0.1	0.48	- 0.08 (0.71)	Z = -2.31 (0.02)
6. When you feel like your hypertension is under control, do you sometimes stop taking your medicine?	0.22	0.34	0.76 (< 0.001)	Z = -1.73 (0.08)

Questions	Corrected Item-to-total correlation (n=30)	Cronbach's alpha if item deleted	Spearman rho coefficient/P value (n = 25)	Wilcoxcon/ P value
7. Taking medication everyday is a real inconvenience for some people. Do you ever feel hassled about sticking to your hypertension treatment plan?	- 0.03	0.47	1 (< 0.001)	Z = 0.00 (>0.99)
8. How often do you have difficulty remembering to take all your medications?	0.33	0.33	0.89 (< 0.001)	Z = -1.41 (0.16)

The Persian Morisky Medication Adherence Scale Cronbach's α = 0.40 and test-retest coefficient = 0.89 (z = -1.11; P value = 0.27)

Table 4. Comparison of our psychometric properties evidences with other studies

	Study population	Alpha coefficient	Test-retest coefficient	Contract validity		Known groups validity	Sensitivity/ Specificity (%)
				Confirmatory factor analysis	Exploratory factor analysis		
Morisky et al. [14]	American hypertensive patients	0.83	-	A fitted One-dimensional scale	-	$\chi^2 = 6.6^*$	93 / 53
Al-Qazaz et al. [21]	Malaysian diabetic patients	0.68	$r = 0.82^*$	-	-	$\chi^2 = 20.261^*$	77.61 /45.37
Korb-Savoldelli et al. [16]	French hypertensive patients	0.54	$ICC = 0.68^*$	One-dimensional scale	One single factor	Fisher exact test =?**	-
Saleem et al. [20]	Pakistani hypertensive patients	0.70	$\rho = 0.8^*$	-	-	$\chi^2 = 19.996^*$	46.15 / 60.0
Reynolds et al. [18]	American patients with Osteoporosis	0.82	$ICC = 0.77^*$	A fitted One-dimensional scale	-	-	-
Kim et al. [22]	Korean hypertensive patients	0.56	$ICC = 0.91^*$	Poor fitted One-dimensional scale	Three factors	$\chi2 = 29.86^*$	64.3 / 72.9
Lee et al. [17]	Korean diabetic patients	0.66	$ICC = 0.79^*$	Not fitted One-dimensional scale	Three factors	$\chi^2 = 10.05^*$	48.6 / 68.8
Sakthong et al. [19]	Thailand diabetic patients	0.61	$ICC = 0.83^*$	-	Three factors	$\chi^2 = 6.7^*$	51 / 64
de Oliveira-Filho et al. [15]	Brazilian-Portuguese hypertensive patients	0.68	$\rho = 0.93^*$	-	-	$\chi^2 = 8.28^*$	86.1 / 31.2
The present study	Iranian hypertensive patients	0.40	$\rho = 0.89^*$	Poor fitted One-dimensional scale	-	Mann-Whitney U test= 8.82^*	-

$*$ P value < 0.05 (r: Pearson coefficient; ICC: Intra class correlation; ρ: Spearman rho coefficient)
? The value was not reported; $**$P > 0.05

Some other studies executed on hypertensive and osteoporosis confirmed the one-dimensional MMAS [14,24,32]. However regarding validating studies, three factors were retrieved from exploratory factor analysis which confirmed the multi-dimensionality of the MMAS-8 [22-23,25]. According to the nature of principle component analysis, it is assumed that variables are numeric and normally distributed, so as such assumptions was not established in our data, we did not execute exploratory factor analysis.

The finding showed that the P-MMAS-8 score had significant difference between blood pressure control groups. Literature review showed that known-groups validity was not significant only in the study of French hypertensive patients [22] (Table 4).

Unlike other studies [14,22,24,26] that reported a good internal consistency (Cronbach's α>0.7), we found unacceptable internal consistency reliability. These results also were against the findings of some other studies that found a moderate internal consistency (Cronbach's α 0.54-0.68) [21-23,28]. However, nearly translated versions of the scale had an alpha below the generally accepted value of 0.70. In present study, the repeatability of the P-MMAS-8 after a two-week interval was excellent. This was in agreement with the other studies (Table 4).

Like all studies, our study had some limitations too. Hospitalized patients participated in the study. Although we paid attention to the patients' comfort status, and their blood pressure was measured by a standard approach, their responses may have been affected by their hospitalization. In addition, it is assumed that one reason of hospitalization may be the low medication adherence supported by our results. Therefore, imbalance degree of adherence in our study sample (more than 90% had low medication adherence) may affect the correlation among the scale items. This may affect sensitivity as well. Other limitations were convenience sampling.

5. CONCLUSION

In conclusion, the results of this study showed that the Persian Morisky Medication Adherence Scale-8 had non-acceptable internal consistency, excellent stability; poor construct validity, and significant known-groups validity. Although some of the psychometric properties of the P-MMAS-8 were acceptable, the P-MMAS-8 did not meet the standard of validity and repeatability. Thus, the P-MMAS-8 is not feasible to use in medical practice in Iranian context. However, the comprehensive measurement of the scale and other factors leading to adherence needed further exploration i.e. the Exploratory Factor Analysis need to be done before Confirmatory Factor Analysis (CFA). The results also suggested that further study is needed to assess the scale within a more adherent population in the context of primary health care through home visitation program. More studies are needed to establish a more appropriate scale in order to be used in the mentioned population.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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