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Original article

Validation of the Chinese version of the eight-item Morisky medication adherence scale in patients with type 2 diabetes mellitus

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ABSTRACT

Background/Purpose: The aim of the present study is to validate the Chinese version 8-item Morisky medication adherence scale (MMAS-8) in patients with type 2 diabetes mellitus (T2DM).
Methods: A cross-sectional survey was conducted. After translation, a convenience sample of 182 patients with T2DM complete the Chinese version MMAS-8, and medication adherence visual analogue scale. The intraclass correlation coefficient and Cronbach α were calculated to determine reliability and internal consistency, respectively. Validity was confirmed using convergent, known group, and construct validity.
Results: The internal consistency determined by Cronbach α was 0.65. Test–retest reliability expressed by intraclass correlation coefficient was 0.80. A positive correlation was observed between Chinese version MMAS-8 and medication adherence visual analogue scale ($r = 0.75$, $p < 0.01$). A significant relationship between MMAS-8 categories and HbA1c categories ($\chi^2 = 21.63$; $p < 0.001$) was found. Factor analysis showed that the MMAS had two dimensions: forgetting to take medications and the complexity of drug regimen; and stopping medication.
Conclusion: The Chinese version of the MMAS-8 is a reliable and valid measure of medication adherence that can now be used in type 2 diabetic patients.

1. Introduction

Diabetes mellitus (DM) is a major health problem with a growing prevalence and high rates of morbidity and mortality. The International Diabetes Federation has concluded that there will be 380 million individuals with diabetes in 2025.[1] In China, a recent study showed that the prevalence of the type 2 DM (T2DM) in adults aged ≥20 years is now 9.7%.[2] It is recognized by the World Health Organization as one of the world's most important public health problems for prevention, diagnosis, and treatment.

Diabetes can be treated by effective medications. Successful blood glucose control could decrease the morbidity and mortality resulting from T2DM complications that place a considerable financial burden on society.[3,4] Although there are many factors that affect glycemic control among patients with diabetes, it is known to be improved by adherence to DM medications, and treatment utility is limited by poor adherence.[5–7] Adherence is defined as "the extent to which a person's behavior—taking medication, following a diet and/or executing lifestyle changes—corresponds with agreed recommendations from the healthcare provider."[8] Several studies have shown that the medication adherence in type 2 diabetic patients ranges from 36% to 93%.[5,7] Cramer[9] has pointed out that many diabetic patients take less than the prescribed amounts of their medications. Poor adherence compromises safety and treatment effectiveness, leading to increasing mortality and morbidity with considerable direct and indirect costs to the healthcare system.[10,11]

Improving adherence to diabetes treatment thus is a vital public health issue. Achieving this requires appropriate tools to measure adherence that can be used to monitor improvements. Tools used to measure adherence include pill counts, electronic monitoring systems, monitoring of drug concentrations in blood and urine, medication records, and self-reports.[12] But the most convenient, least expensive, and easiest way to assess medication adherence is self-reporting. Morisky et al[13] developed a four-item self-report questionnaire to assess medication adherence, which is widely used but has shown poor psychometric properties. Recently, an eight-item Morisky medication adherence scale (MMAS-8) has

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been developed,[14] which has better psychometric properties than the previous four-item scale.

Although the MMAS-8 has been validated in other languages,[15,16] this questionnaire has not been translated into Chinese. Thus, the goal of the present study was to verify the reliability and validity of the Chinese version MMAS-8 among patients with T2DM.

2. Methods

2.1. Participants

For this validation study, 182 outpatients from the Diabetic Care and Research Center of Jiangsu Province Geriatric Institute were consecutively recruited from May 2012 to September 2012. Inclusion criteria were: (1) patients had been diagnosed with T2DM at least 1 year earlier; (2) patients use antidiabetes medications; and (3) patients are able to communicate in the Chinese language. Patients who met all three criteria were included. Patients who had severe health problems or cognitive impairments and could not complete interviews were excluded. Informed consent was obtained from each participant prior to entering the study and the study was approved by the ethics committee of Jiangsu Province Geriatric Institute.

2.2. Data collection

The data on demographic and clinical characteristics of participants was collected. All patients were asked to complete the Chinese version of MMAS-8 and Adherence Visual Analogue Scale (MA-VAS). A sample of 41 patients selected randomly filled out the MMAS-8 again after 30 days.

The following data on demographic and clinical characteristics were compiled: age, sex, height and weight (for body mass index calculation), education, duration of diabetes, and hemoglobin A1C (HbA1c). DM was defined as fasting glycemic values $\geq$126 mg/dL, or with a previous diagnosis and use of medication for the treatment of diabetes.[17]

The Chinese version MMAS-8 was translated according to Beaton's guidelines for the process of translation and cross-cultural adaptation of self-report measures.[18] The Chinese version MMAS-8 was independently translated into Chinese by two bilingual translators with the Chinese mother tongue and then translated back by two native English-speaking translators. Inconsistencies in translation among translators were resolved by discussion. A review committee was formed to examine the translations, then the Chinese version MMAS-8 was developed, which was culturally applicable and reflected the intent of the instrument.

The Chinese version MMAS-8, a self-administered rating scale for assessing medication adherence, contains eight items. Each item is measuring a specific behavior and is not a determinant of adherence behavior.[19] Response choices are yes/no for items 1–7 and a 5-point Likert response for the last item. Each response of "no" is rated as "1" and each "yes" is rated as "0" except for Item 5, in which each response of "yes" is rated as "1" and each "no" is rated as "0". For Item 8, if a patient chooses response "0", the score is "1" and if they choose response "4", the score is "0". Responses "1", "2", and "3" are rated as "0.25", "0.75", and "0.75", respectively. The total score on the MMAS-8 can range from 0 to 8, where higher scores indicate higher adherence. The degree of adherence was determined according to the score resulting from the sum of all the correct answers: low adherence (<6 points), medium adherence (6 to <8 points), and high adherence (8 points). In this study, patients were considered adherent when they had a score equal to eight in the MMAS-8.

The medication adherence visual analogue scale (MA-VAS) is another self-reported instrument for assessing medication adherence.[20] For this, a respondent is shown a line with endpoints of "no medication adherence at all" at 0 and "full medication adherence" at 10.

2.3. Measurements

A test is useful when it measures what it is intended to measure (validity) and when the results stay consistent across repeated measurements over time (reliability).

To determine the reliability of the MMAS-8, internal consistency and test–retest reliability were calculated. In this study, a second Chinese version MMAS-8 was administered to the subsample selected randomly 30 days later for test–retest reliability; a period long enough not to remember the exact answers from the first time and short enough not to expect a therapy effect.[21]

Validity was determined by measuring the convergent, known group, and construct validity.

Convergent validity was evaluated using Spearman's correlation coefficients to assess the association between the MMAS-8 and MA-VAS. Known group validity was assessed through the association of MMAS-8 categories (high, medium, and low adherence) and A1C levels ($\geq$7% and <7%). Construct validity was tested using an exploratory factor analysis.

2.4. Statistical analysis

Descriptive statistics were used to describe demographic and clinical characteristics of patients and their medication adherences scores. Percentages and frequencies were used for the categorical variables, whereas means and standard deviations were calculated for the continuous variables. The characteristics of the whole sample and of the adherent groups were presented. The Chi-square (χ^2) test was employed for categorical variables and analysis of variance (ANOVA) tests were used to evaluate the differences between three adherent groups. Cronbach α was employed to evaluate internal consistency. Test–retest reliability was assessed with the intraclass correlation coefficient (ICC) of absolute agreement based on a two-way mixed model.[22] The criterion for accepting Cronbach α is a score above 0.5.[23,24] The criteria for interpretation of ICCs are based on Rosner (suggesting that ICC <0.40 = poor agreement, ICC 0.40–0.75 = fair to good agreement, ICC $\geq$ 0.75 = excellent agreement).[25]

Convergent validity was assessed using Spearman rank correlation between MMAS-8 and MA-VAS using Spearman's rho. Correlations were interpreted using the following criteria: 0–0.25 = little or no correlation; 0.25–0.5 = fair correlation; 0.5–0.75 = moderate to good correlation; and >0.75 = very good to excellent correlation.[25] Known group validity was assessed through the association of HbA1c levels ($\geq$7% and <7%) and MMAS-8 categories using χ^2 tests. The factor analysis evaluating construct validity was conducted by a principal component analysis, followed by Varimax rotation with Kaiser normalization. Kaiser's eigenvalue >1 was used to determine the number of factors. Factor loadings >0.4 on each item were considered to belong to the corresponding factors.[26]

The significance of the statistical tests was set at 0.05. Statistical analysis was performed with SPSS version 16.0 for windows.

3. Results

Baseline demographic and clinical characteristics of the total and adherent groups are shown in Table 1. Of the 182 patients with T2DM, 49 (26.9%), 76 (41.8%), 57 (31.3%) were in the low, medium,

Table 1
Demographic and clinical characteristics of the participants ($n = 182$).

Characteristics	Total ($n = 182$)	Low adherence ($n = 49$)	Medium adherence ($n = 76$)	High adherence ($n = 57$)	F/χ^2	*P*
Age (y)	64.90 ± 9.57	61.30 ± 10.70	65.70 ± 8.23	66.93 ± 9.53	5.24	0.006
Female	72.5	71.4	67.1	80.7	3.06	0.216
BMI (kg/m^2)	24.24 ± 4.30	24.39 ± 4.22	24.34 ± 4.03	24.00 ± 4.73	0.135	0.874
Education level						
Primary and below	3.8	4.1	1.3	7.0	3.84	0.428
Secondary school	34.6	30.6	39.5	31.60		
College and above	61.5	65.3	59.2	61.40		
Diabetic duration (y)	8.29 ± 6.43	7.41 ± 5.88	9.00 ± 6.29	8.09 ± 7.04	0.95	<0.001
HbA1c	6.74 ± 0.84	7.12 ± 0.86	6.73 ± 0.88	6.42 ± 0.64	10.12	<0.001
MA-VAS score	8.75 ± 1.30	7.65 ± 1.49	8.95 ± 1.01	9.41 ± 0.77	35.89	<0.001
MMAS-8 score	6.46 ± 1.54	4.42 ± 1.14	6.64 ± 0.55	8.00 ± 0.00	360.69	<0.001

Data are presented as % or mean ± SD, unless otherwise indicated.
BMI = body mass index; MA-VAS = adherence visual analogue scale; MMAS-8 = 8-item Morisky medication adherence scale.

and high adherence groups, respectively. Significant differences were found in age, HbA1c levels, duration of diabetes, MA-VAS score, and MMAS-8 score ($p < 0.05$). No significant differences were observed among the three groups in terms of sex, body mass index, and educational level.

3.1. Reliability

The α coefficients were 0.65 for the Chinese version MMAS-8, which is below 0.7 but higher than 0.5.[23,24] The ICC determining the test–retest reliability was 0.8, which indicates the high stability of the Chinese version MMAS-8.

3.2. Convergent validity

MMAS-8 was positively associated with the MA-VAS ($r = 0.75$, $p < 0.01$).

3.3. Known group validity

As shown in Table 2, a significant relationship between MMAS-8 categories and HbA1c categories ($\chi^2 = 21.63$, $p < 0.001$) was found. Around 37.6% (47/125) of the low adherence patients were in the poor glycemic control group, while 82.5% (47/57) of those in the high adherence group were in the good glycemic control group.

3.4. Construct validity

Exploratory factor analysis showed two factors with eigenvalues >1, which explained 45.4% of the total variance. Factor loadings between the eight items of MMAS-8 and the two factors are presented in Table 3. Factor 1 comprised Items 1, 2, 4, 7, and 8, which mostly involved patients forgetting to take medications and the complexity of the drug regimen. Factor 2 consisted of Items 3, 5, and 6, which were viewed as patients stopping medications when they were feeling better or worse.

Table 2
The relationship between MMAS-8 and blood glucose control ($n = 182$).

	HbA1c ≥ 7% (poor control)	HbA1c < 7% (good control)	χ^2	*p*
Low adherence (MMAS < 6)	28 (57)	21 (43)	21.630	0.000
Medium adherence (MMAS 6–8)	19 (25)	57 (75)		
High adherence (MMAS = 8)	10 (18)	47 (82)		

Data are presented as *n* (%).
MMAS-8 = 8-item Morisky medication adherence scale.

4. Discussion

The main aim of this paper was to report the reliability and validity of the translated version of the MMAS-8 in patients with diabetes. This study was the first to systematically translate and validate the eight-item MMAS into the Chinese language. Other studies evaluate the MMAS-8 in diabetes patients in Thailand and in Malaysia.[15,16] The original MMAS-8 was tested by Morisky et al[14] on a sample of hypertensive patients, and it was found that the scale was reliable with good predictive validity. The Malaysian study among Malaysian patients with diabetes showed that the MMAS-8 had good test–retest reliability with good convergent validity.[15] The Thailand study showed that the MMAS-8 had good convergent validity with good test–retest reliability in Thai patients with T2DM.[16] Our study demonstrates that the Chinese version MMAS-8 had good test–retest reliability with good convergent validity.

As for reliability, the Chinese version MMAS-8 had excellent test–retest reliability (ICC = 0.80), whereas internal consistency reliability was moderate (Cronbach α = 0.65). Our result is different from that of Morisky et al.[14] They reported that the MMAS-8 had a Cronbach α of 0.83. But our result is consistent with the Thailand and Malaysian studies.[15,16] An explanation for the unacceptable α value in our study is that sample size was smaller than the sample

Table 3
Exploratory factor analysis of the Chinese version 8-item Morisky medication adherence scale in patients with type 2 diabetes ($n = 182$).

Item	Factor 1	Factor 2
1. Sometimes forget to take medications?	**0.672**	0.121
2. Over the past 2 weeks, were there any days when you did not take your diabetes medicine?	**0.644**	0.167
3. Have you ever cut back or stopped taking your medication without telling your doctor because you felt worse when you took it?	0.148	**0.684**
4. When you travel or leave home, do you sometimes forget to bring along your medications?	**0.552**	0.110
5. Did you take your diabetic medicine yesterday?	0.106	**0.775**
6. When you feel like your diabetes is under control, do you sometimes stop taking your medicine?	0.344	**0.430**
7. Taking medication every day is a real inconvenience for some people. Do you ever feel hassled about sticking to your diabetes treatment plan?	**0.663**	0.102
8. How often do you have difficulty remembering to take all your diabetes medication?	**0.728**	−0.141

used in previous studies as internal consistency is actually a correlation coefficient and the sample size can affect the result.[27] Another explanation of the lower α value is that most of the items on the scale use a binary response (yes/no), and if more response choices were applied like the five-level Likert scale, the α value would improve because the lower measurement error is associated with more response options.[28]

For validity, three aspects are considered: convergent validity, known group validity, and construct validity. In the present study, Chinese version MMAS-8 was associated with MA-VAS, thus confirming the convergent validity. These results corroborate the results obtained by other MMAS-validation studies.[15,16] As for known-groups validity, although there was a significant association between the Chinese version MMAS-8 results and blood glucose control ($\chi^2 = 21.63$; $p < 0.001$), indicating that the instrument was able to differentiate between patients who were clinically different. Glycemic control represented by HbA1c was found to be significantly related with MMAS-8 scores, in which lower HbA1c (better glycemic control) was associated with higher adherence scores. As for construct validity, two known-groups mensional scales were shown. It is different from the study results of Morisky et al,[14] but similar to that of Sakthong et al.[16] This kind of scale multidimensionality may be another explanation for the α value in our study.

In conclusion, the findings of this study provide initial support for the reliability and validity of the Chinese version MMAS-8. The Chinese version MMAS-8 is a valid and reliable instrument for assessing medication adherence in patients with T2DM. Further testing of the measure is needed with a larger, more diverse group of patients across different Chinese sociocultural contexts and patients with different diseases. In the future, studies aiming to investigate if the Chinese version MMAS-8 is able to detect the effect of intervention should also be conducted.

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