Validation of a French Version of the 8-Item Morisky Medication Adherence Scale in Hypertensive Adults

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The aim of this study was to validate a French translation of the structured self-report 8-item Morisky Medication Adherence Scale (MMAS-8) and determine its psychometric properties in patients taking antihypertensive medication. An observational cross-sectional study was conducted in the hypertensive unit of a French university hospital. The MMAS-8 was translated according to international guidelines. Internal consistency was assessed using Cronbach α coefficient, construct validity using principal component and confirmatory factor analyses, and the test-retest reliability at 1-month interval using the intraclass correlation coefficient (ICC). Three levels of adherence were considered (low: scores of 0 to <6; medium: 6 to <8; high: 8) and risk factors were explored in ordinal logistic regression models. A total of 199 patients were included: mean age, 55.7 ± 14.6 years, 57.3% men (114 of 199), and 39.5% (66 of 167) had uncontrolled blood pressure. The French MMAS was moderately reliable (α=0.54), one-dimensional, and reproducible (ICC=0.68). The mean score was 6.96 (standard deviation 1.25) and 17.6% (35 of 199), 37.7% (75 of 199), and 43.7% (87 of 199) of patients had low, medium, and high adherence, respectively. The only factor significantly associated with adherence was age. The French MMAS has acceptable psychometric effects to measure medication adherence in hypertensive patients and may be useful in detecting nonadherent hypertensive patients. *J Clin Hypertens (Greenwich).* 2012; 14:429–434.

Adherence to antihypertensive medication is a key determinant of adequate blood pressure (BP) control and prevention of cardiovascular outcomes.[1] Several studies have underlined the association between low adherence to antihypertensive drug therapies and uncontrolled hypertension.[2] In a study by Mazzaglia and colleagues,[3] high adherence was associated with a 38% decreased risk of cardiovascular events compared with lower adherence. Nevertheless, according to various studies, the percentage of adherent patients varies from 50% to 70%.[4] In France, an epidemiologic study demonstrated that 49% of treated patients had persistent high BP,[5] the main reason for which, according to some authors, is nonadherence to antihypertensive drug therapies.

Identifying adherence-related behaviors of hypertensive patients is an important step towards improving compliance and patient education and, for this, numerous direct and indirect tools have been proposed. However, to date, no tool has been identified as the gold standard and no single scale is appropriate for every setting. The information gained from measurement of adherence can help to achieve optimum outcomes. Adherence measurement should be accurate and allow understanding of patients' adherence barriers to their medication.[6] The choice of the specific measure used in clinical practice depends on the intended use of the information, the resources available to the provider, and the patient's acceptance and convenience of the method.[7] Currently, adherence is determined by self-reported assessment and through interviews conducted during office visits. Self-reporting methods include patient-kept diaries of medication-taking and responses to adherence-specific questionnaires.

The second most commonly used adherence-specific self-report questionnaire in the literature[6] is the Morisky Medication Adherence Scale (MMAS).[8] The reliability and validity of this scale was originally established as a 4-item questionnaire in patients with hypertension and then used for numerous chronic disorders. Advantages of the MMAS include simplicity of the questions and ease of scoring. It has recently been expanded with 4 additional items addressing the circumstances surrounding adherence behavior.[9] The updated version of the MMAS (MMAS-8) has better psychometric properties than the original 4-item version. Scores obtained from this scale range from 0 to 8, where higher scores indicate higher adherence.

Reviewing properties of the tools, such as simplicity of administration and scoring, reliability, generalizability,

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and sensitivity/specificity, as well as validation populations, is a crucial step when selecting a questionnaire. The MMAS-8 has been adapted in Thailand and Malaysia for diabetes patients[10,11] and in Sweden for human immunodeficiency virus–positive patients.[12] However, no French version of the MMAS-8 has been validated to date. Translation, cross-sectional adaptation and validation of the MMAS in French are prerequisites to its routine use in clinical practice. Furthermore, development of a French version of MMAS-8 would allow French investigators to participate in international research studies when this scale is proposed.

The main objective of this study was to validate a French translation and culturally adapted version of the MMAS-8 and to examine its psychometric properties in patients with hypertension. The secondary objectives were to use the French MMAS to measure adherence of hypertensive patients treated with antihypertensive medications and to explore factors associated with nonadherence.

PATIENTS AND METHODS

Design and Setting

This observational cross-sectional single-center study was conducted in the daycare hypertensive unit of the cardiovascular department of the European Georges Pompidou Hospital, an 800-bed teaching hospital.

8-Item MMAS

The MMAS-8 was designed to facilitate identification of barriers to and behaviors associated with adherence to hypertensive medication.[13] It is a self-report questionnaire with 8 questions (items). The questions were formulated to avoid a ''yes-saying'' bias, ie, the wording of the item 5 is reversed to prevent the tendency to respond in a specific way to a series of questions regardless of their content.

Response choices are yes/no for items 1 through 7 and a 5-point Likert response scale for the last item. Each response ''no'' is rated as ''1'' and each ''yes'' is rated as ''0'' except for item 5, in which each response ''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, 3'' are respectively rated as ''0.25, 0.75, 0.75.'' The total score on the MMAS-8 can range from 0 to 8, with scores of <6, 6 to <8, and 8 reflecting low, medium, and high adherence, respectively.

Translation and Cross-Cultural Adaptation of the MMAS-8

The 8 items of the questionnaire were translated according to international guidelines[14] as follows: (1) two independent French translations were obtained from two independent bilingual translators without any mutual consultation. Cross-cultural adaptation was achieved during a consensus meeting attended by French physicians and pharmacists. (2) The reverse translation from French to English was carried out by another bilingual translator who was not involved in developing the initial version. (3) The original and the back-translated English versions were compared and inconsistencies were resolved in a consensus meeting. A pilot test was performed in a French population (n=10) to ensure patient understanding of the wording of the French version and no inconsistencies were revealed. The patients who participated in this face-validity phase were not included further in the study. The questionnaire takes about 5 minutes to complete.

Patients and Study Design

Patients attending the outpatient hypertensive unit between March 2010 and May 2011 were invited to participate. To be included in the study, patients had to (1) be treated with antihypertensive medications, (2) be able to read French, (3) be older than 18 years, and (4) sign a written consent.

At admission, nurses asked the included patients to complete the questionnaire. In order to respect the confidentiality of responses and to reduce the social desirability bias, completed questionnaires were collected by a pharmacist and the patient's physician did not have access to the data. One month after admission, the questionnaire was sent to each patient's home and they were asked to complete it again.

Ethics and Informed Consent

The study was conducted according to good clinical practice for biomedical studies according to French regulation. The study protocol and informed consent form was approved by an ethics committee (Conseil d'éthique de Necker). The study was explained to all potentially eligible patients attending the hypertensive unit. Inclusion was validated after written informed consent was signed by the patient.

Data Collection

Collected data included the responses to the French MMAS at and 1 month after admission; BP values and sociodemographic characteristics were extracted from patient charts.

Statistical Analysis

Sample Size. Costello and Osborne[15] empirically tested the effect of sample size on the results of factor analysis and reported that 70% of the samples with a ratio (sample size: number of items) of 20:1 produced correct factorial structure. This corresponds to 160 patients for an 8-item questionnaire. With this sample size, the width of the 95% confidence interval (CI) for a Cronbach α coefficient of 0.80 is ± 0.05.[16] We decided to include 200 patients to allow for a maximum of 20% of missing or incomplete questionnaires.

Missing Data. As recommended by Morisky, the MMAS-8 score could be calculated if the respondent answered at least 75% of the items (at least 6 of 8 items). When an item was missing, the median score of respondents to this item was substituted.

Psychometric Properties of the French MMAS Questionnaire. The internal consistency was assessed using Cronbach α coefficient. Nunnally and Bernstein[17] suggested 0.70 as an acceptable reliability coefficient. The 95% CI for Cronbach α coefficient was calculated using the exact method of Koning and Franses.[16] The structure validity of the questionnaire was analyzed by a principal component analysis (PCA) with varimax rotation. The number of components to retain in the PCA was examined using Horn's parallel analysis (1000 iterations) and confirmatory factor analysis. The intraclass correlation coefficient (ICC)[18] was used to assess test-retest reliability at a 1-month interval.

Risk Factors of Nonadherence. We performed an explanatory analysis to study whether the demographic and clinical variables were associated with adherence according to the French MMAS. The risk factors explored were age, sex, current smoking status, regular exercise or sport, diastolic BP, systolic BP, controlled current BP (defined as diastolic BP <90 mm Hg and systolic BP <140 mm Hg), duration of treatment, and number of antihypertensive medication classes. Ordinal logistic regression models were used to consider the 3 ordinal levels of adherence (low/medium/high). This model compared adjacent levels: the odds ratio (OR) corresponded with the odds of adherence in the next lower level. All risk factors were studied in univariable and multivariable analyses. The ORs are presented with their 95% confidence intervals (CIs). SAS statistical software (release 9.2; SAS Institute Inc, Cary, NC) was used for all analyses.

RESULTS

Clinical and Demographic Data

The sociodemographic characteristics of the 199 patients are presented in Table I. The mean age was 55.7±14.6 years, and 57.3% (114 of 199) were men, 60.5% (101 of 167) had controlled current BP, and 39.5% (66 of 167) were uncontrolled (32 missing responses).

TABLE I. Sociodemographic Characteristics of the Population

	No.	No. (%), Mean±Standard Deviation, or Median (Interquartile Range)
Demographic characteristics		
Men	199	114 (57.3)
Age, y	199	55.7±14.6
Lifestyle		
Current smoker	195	37 (19.0)
If yes, number of cigarettes per day	37	10 (4–20)
If no, length of smoking cessation, y	44	13 (5–26)
Regular exercise or sport	180	40 (22.2)
Alcohol (mean number of drinks per day)	172	
0		117 (68.0)
1 or 2		39 (22.7)
>2		16 (9.3)
Clinical characteristics		
Diastolic blood pressure, mm Hg	167	80.1±11.9
Systolic blood pressure, mm Hg	167	134.1±20.5
Diastolic blood pressure by self-measure, mm Hg	93	85.8±11.5
Systolic blood pressure by self-measure, mm Hg	97	139.3±17.6
Pulse rate, mean, beat per min	121	69.0±11.4
Hypertension		
Duration of hypertension, y	177	12 (4–21)
Duration of regular antihypertensive treatment, y	162	8 (2–18)
Current blood pressure control	167	
Controlled		101 (60.5)
Noncontrolled		66 (39.5)
Antihypertensive treatments		
Number of therapeutic classes	195	2 (1–3)
Angiotensin II antagonist		72 (36.9)
Thiazide		70 (35.9)
β-Blocker		58 (29.7)
Calcium channel blocker		53 (27.2)
Angiotensin-converting enzyme inhibitor		37 (19.0)
Central antihypertensive		32 (16.4)
Loop diuretic		21 (10.8)
Aldosterone blocker		18 (9.2)
Potassium-sparing diuretic		17 (8.7)
α-Blocker		16 (8.2)
Other		6 (3.1)
Vasodilatator		2 (1.0)

Psychometric Properties of the French MMAS

Descriptive Results of the Score. We applied Morisky's procedure to substitute the missing value for the two missing responses (item 7) (Table II). The mean score for the medication adherence scale was 6.96 (standard deviation 1.25) and the median (interquartile range [IQR]) was 7 (6–8). Using the recommended cut-offs, 17.6% (35 of 199), 38.2% (76 of 199), and 44.2% (88 of 199) of patients were in the low, medium, and high adherence groups, respectively. These proportions were 19.8% (20 of 101), 35.6% (36 of 101), and 44.5% (45 of 101) in patients with controlled BP and 12.1% (8 of 66), 42.4% (28 of 66), and 45.4% (30 of 66) in those patients uncontrolled BP (difference not significant, Fisher exact test, P=.41).

Reliability/Internal Consistency. Overall standardized Cronbach α coefficient was 0.54 (95% CI, 0.44–0.63) for the 8 items of the French MMAS. The item-total

TABLE II. Corrected Item-to-Total Correlation and Factors Loading of the French MMAS

Items	Patients' Responses	Entry (n=199), No. (%)	Corrected Item-to-Total Correlation	Factors Loading[a]
Do you sometimes forget to take your antihypertensive pills?	No	136 (68.3)	0.39	**0.70**
People sometimes miss taking their medications for reasons other than forgetting. Thinking over the past 2 weeks, were there any days when you did not take your antihypertensive medicine?	No	165 (82.9)	0.42	**0.62**
Have you ever cut back or stopped taking your medication without telling your doctor, because you felt worse when you took it?	No	177 (88.9)	0.24	**0.44**
When you travel or leave home, do you sometimes forget to bring along your antihypertensive medication?	No	175 (87.9)	0.31	**0.59**
Did you take your antihypertensive medicine yesterday?[b]	Yes	191 (96.0)	**−0.05**	−0.11
When you feel like your antihypertensive is under control, do you sometimes stop taking your medicine?	No	191 (96.0)	0.17	0.33
Taking medication everyday is a real inconvenience for some people. Do you ever feel hassled about sticking to your antihypertensive treatment plan?	No	168 (84.4)[c]	0.20	0.33
How often do you have difficulty remembering to take all your medications?	Never/rarely once in a while sometimes usually, all the time	151 (75.9) 29 (14.6) 17 (7.0) 4 (2.0) 1 (0.5)	0.43	**0.74**

Abbreviation: MMAS, Morisky Medication Adherence Scale. Bold values indicate significance. [a]A single factor was retained after varimax rotation and explained 27.5% of the variance. [b]Patients had to answer ''yes'' to be considered adherent. [c]Two missing responses. Cronbach α reliability coefficient=0.54.

correlations ranged from −0.05 (item 5) to +0.43 (item 8) (Table II). Standardized Cronbach α coefficient was slightly higher (0.61) when item 5 was not used for computation.

Construct Validity. Horn's parallel criteria retained one component in the PCA indicating that the 8-item scale was one-dimensional. Confirmatory factor analysis confirmed that the French MMAS was one-dimensional but the association between item 5 and ''medication adherence'' (represented by the factor summarizing the variables of the questionnaire) was not significant. The PCA indicated that the first component accounts for 27.5% of variance in the dataset (55.2% for the first 3 components). Five items had factor loadings >0.4 (items 1, 2, 3, 4, and 8) on the first component of the PCA. Item 8 had the highest correlation with the first component of the PCA (r=0.74), followed by item 1 (r=0.70) and item 2 (r=0.62). When 3 factors were extracted from the PCA with varimax rotation, factor loadings were >0.6 on the first component for items 1, 4, and 8 (items about forgetting), >0.7 on the second component for items 3 and 6 (items about stopping when feeling worse or better), and >0.5 on the third component for items 2, 5, and 7 (items with notion of time).

Reproducibility. A total of 117 questionnaires were returned 1 month after admission. The mean score for the medication adherence scale was 7.15 (SD 1.06) and median (IQR) was 8 (7–8). Using the recommended cut-offs, 13.7% (16 of 117), 36.8% (43 of 117), and 49.6% (58 of 117) of patients were in the low, medium, and high adherence groups, respectively. The mean score at admission for the 117 patients who returned the questionnaire was 7.13 (SD 1.05) and median (IQR) was 8 (7–8).

The test-retest reliability of the French MMAS indicates good reliability at a 1-month interval with an ICC of 0.68 (95% CI, 0.63–0.72).

Risk Factors of Nonadherence. In univariable analysis, there was a statistically significant increase in risk of lower adherence with younger age, smoking status, smaller duration of treatment, and higher number of therapeutic classes (Table III). After adjustment for all potential risk factors of low adherence, the only factor significantly associated with adherence was age. For a 10-year increase in age, the odds of having a lower adherence decreased by 25% (adjusted OR, 0.75; 95% CI, 0.63–0.89; P=.001). Current smokers tended to have a higher risk of low adherence (increased by 91%), but this did not reach statistical significance (adjusted OR, 1.91; 95% CI, 0.86–4.25; P=.113).

DISCUSSION

This study reports on the development and the psychometric properties of the MMAS-8 translated and adapted to the French language. The French MMAS displays acceptable psychometric properties: the scale

TABLE III. Determinants of Adherence Levels

Parameters	Low Adherence <6 (n=35)	Medium Adherence 6 to <8 (n=76)	High adherence 8 (n=88)	Nonadjusted OR (CI 95%)[a]	*P* Value[b]	Adjusted OR (CI 95%)[a]	*P* Value[b]
Age	47.03±13.53	53.93±14.50	60.78±13.10	0.79 (0.71–0.87)[c]	<.0001	0.75 (0.63–0.89)[c]	.001
Sex				1	.166		.225
Female	16 (45.7)	37 (48.7)	32 (36.4)	0.69 (0.41–1.17)		1	
Male	19 (54.3)	39 (51.3)	56 (63.6)			0.66 (0.33–1.29)	
Current smoker				1	.042		.113
No	21 (60.0)	41 (53.9)	55 (62.5)	2.01 (1.03–3.92)		1	
Yes	8 (22.9)	19 (25.0)	10 (11.4)			1.91 (0.86–4.25)	
Sport				1	.973		.812
No	22 (62.9)	56 (73.7)	62 (70.5)	0.99 (0.51–1.92)		1	
Yes	8 (22.9)	13 (17.1)	19 (21.6)			0.91 (0.40–2.05)	
Controlled current BP					.559		.924
No	8 (22.9)	28 (36.8)	30 (34.1)	1		1	
Yes	20 (57.1)	36 (47.4)	45 (51.1)	1.19 (0.66–2.14)		1.06 (0.35–3.13)	
Duration of treatment, y	6.33±6.50	10.98±10.21	14.05±11.34	0.79 (0.68–0.92)[c]	.002	1.03 (0.86–4.25)[c]	.747
Diastolic BP, mm Hg	81.04±16.91	81.36±9.90	78.67±11.13	1.19 (0.94–1.52)[d]	.152	1.04 (0.67–1.64)[d]	.852
Systolic BP, mm Hg	126.71±22.37	134.42±20.41	136.60±19.57	0.87 (0.75–1.00)[d]	.051	1.10 (0.79–1.52)[d]	.584
Number of therapeutic classes	2.27±1.10	2.33±1.40	2.83±1.52	0.79 (0.65–0.96)	.020	0.88 (0.66–1.16)	.360

Abbreviations: BP, blood pressure; CI, confidence interval; OR odds, ratio. Values are expressed as number (percentage), mean±standard deviation, or median (interquartile range). [a]Odds of having adherence in the next lower level. [b]From univariable ordinal logistic regression model. [c]For 5-year increase. [d]For 10-mm Hg increase. [e]From multivariable ordinal logistic regression model (n=146 patients).

was one-dimensional, reproducible (ICC=0.68 [0.63–0.72]), and the reliability was moderate (Cronbach α=0.54; 95% CI, 0.44–0.63). Most of the included patients were highly adherent, and age was significantly associated with adherence.

In the present study, the French MMAS was validated in hypertensive patients as it was for the original MMAS-8. Compared with the MMAS-8, the psychometric properties of the French MMAS seemed to be lower, especially for internal consistency. One explanation might be due to differences in the population studied during the development of the original MMAS-8: our patient sample size was lower, there were more men, and more patients had high adherence. Like the original MMAS-8, the French MMAS structure analysis disclosed a single dimension; however, item 5 had a low factor loading. This is probably due to a recall bias because the item questions patients about their medication intake of the day before. The moderate internal consistency reliability we found is similar to that of two other studies that validated Thai and Malay versions of the MMAS-8 in diabetes patients.[10,11] Test-retest reliability is correct for all the MMAS-8 translations. Contrary to Morisky and colleagues,[9] we did not find a significant link between adherence and BP control. Thai and Malaysian versions, validated among diabetic patients, did not also find a strong link between glycemic control and adherence scores. Our result could be explained by the characteristic of our population with a lower number of included patients than Morisky and colleagues and a higher proportion of adherent patients.

Exploratory analysis of risk factors of nonadherence by multivariable modeling indicated a significant association between age and adherence (a decrease in risk of lower adherence for older patients). In the Thai and Malaysian studies, mean patient age was highest in the high adherence group. After adjustment for age, Morisky and colleagues found that knowledge, patient satisfaction, coping, stress level, and medication complexity were significantly associated with adherence. Similar to our results, the study by Fodor and colleagues[19] conducted in three European countries, showed that younger patients were less likely to be adherent with antihypertensive drugs, and that is in accordance with numerous data in the literature.[20,21] In the present study, the duration of treatment and the number of antihypertensive classes were associated with a lower adherence.

As in other studies about medication adherence, smokers tend to be less adherent. Some authors suggest that individuals who do not have a healthy lifestyle are less likely to adhere to a treatment regimen on a long-term basis.[21]

LIMITATIONS

The main limitation of our results is that the study was conducted in a single center with hypertensive patients making generalization to other diseases difficult. Another limitation is that we did not compare the adherence results of the French MMAS with an objective method of measurement, such as electronic monitoring. Furthermore, the risk factors found in the present study should be interpreted with caution because they were found during the validation process

of the questionnaire rather than during a dedicated study of adherence determinants.

CONCLUSIONS

Identifying patients who have difficulty in adhering to a therapeutic regimen is fundamental for an antihypertensive treatment to be effective.[20] The French MMAS is a reliable and valid measure of medication adherence in hypertensive patients. This questionnaire should be used specifically in patients with uncontrolled BP despite an appropriate antihypertensive medication and to develop strategies to improve adherence. The French version of this questionnaire could help to initiate dialogue between physician and patient about antihypertensive medication. Indeed, the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure[22] recommends a patient-centered strategy to build trust and increase communication with physicians in order to achieve BP goals. In clinical practice, the main qualities of the French MMAS are its simplicity and quickness and its possible use in other chronic pathologies.

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