

# Reliability and known-group validity of the Arabic version of the 8-item Morisky Medication Adherence Scale among type 2 diabetes mellitus patients

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موثوقية النسخة العربية من مقياس موريسكي ذي البنود الثمانية الخاص بالالتزام بالمداداة بين مرضى السكري من النمط 2، ومصداقية هذه النسخة لدى مجموعات معروفة  
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الخلاصة: لم يسبق أن أجريت دراسة لتوثيق مصداقية النسخة العربية من مقياس موريسكي ذي البنود الثمانية (MMAS-8<sup>®</sup>) كمقياس للالتزام بالمداداة بين مرضى السكري. لقد قامت هذه الدراسة في عام 2013 باختبار موثوقية ومصداقية النسخة العربية من MMAS-8 لدى مرضى السكري من النمط 2 الذين يراجعون مركز إحالة في طرابلس بليبيا. حيث قامت عينة راحة تضم 103 مريضاً بملاء ذاتي للاستبيان. وتم اختبار الموثوقية باستخدام كرونباخ ألفا ووسيطي الارتباط بين البنود ومُعامل سبيرمان- براون. وتم اختبار المصداقية لدى مجموعات معروفة بمقارنة الدرجات المحرزة على MMAS-8<sup>®</sup> لمرضى مصنفين في مجموعات بحسب ضبط سكر الدم. فأظهرت النسخة العربية اتساقاً داخلياً كافياً ( $\alpha = 0.70$ ) وموثوقية متوسطة لدى النصف المشطور ( $r = 0.65$ ). كما أُيدت مصداقية المجموعات المعروفة بوجود ارتباط كبير بين الالتزام بالمداداة وبين ضبط سكر الدم، مع وجود حجم تأثير معتدل ( $\phi_c = 0.34$ ). أثبتت الدراسة أنه لدى النسخة العربية خصائص سيكومترية جيدة، وبذا يمكنها أن تدعم الأبحاث والممارسات المتعلقة بالسكري في البلدان العربية.

ABSTRACT No validation study has previously been made for the Arabic version of the 8-item Morisky Medication Adherence Scale (MMAS-8<sup>®</sup>) as a measure for medication adherence in diabetes. This study in 2013 tested the reliability and validity of the Arabic MMAS-8 for type 2 diabetes mellitus patients attending a referral centre in Tripoli, Libya. A convenience sample of 103 patients self-completed the questionnaire. Reliability was tested using Cronbach alpha, average inter-item correlation and Spearman-Brown coefficient. Known-group validity was tested by comparing MMAS-8 scores of patients grouped by glycaemic control. The Arabic version showed adequate internal consistency ( $\alpha = 0.70$ ) and moderate split-half reliability ( $r = 0.65$ ). Known-group validity was supported as a significant association was found between medication adherence and glycaemic control, with a moderate effect size ( $\phi_c = 0.34$ ). The Arabic version displayed good psychometric properties and could support diabetes research and practice in Arab countries.

## Fiabilité et validité par groupe connu de la version en langue arabe du questionnaire de Morisky à 8 items sur l'adhésion au traitement chez des patients atteints de diabète de type 2

RÉSUMÉ Aucune étude de validation n'a été menée pour la version en langue arabe du questionnaire de Morisky à 8 items (*Morisky Medication Adherence Scale* - MMAS-8<sup>®</sup>) visant à mesurer l'adhésion au traitement du diabète. La présente étude menée en 2013 a testé la fiabilité et la validité de la version en langue arabe de l'échelle MMAS-8 chez des patients atteints de diabète de type 2 consultant dans une clinique de recours à Tripoli (Libye). Dans un échantillon de proximité, 103 patients ont rempli l'autoquestionnaire. La fiabilité a été testée à l'aide de l'alpha de Cronbach, de la corrélation moyenne entre item et du coefficient de Spearman-Brown. La validité par groupe connu a été testée en comparant les scores MMAS-8 des patients regroupés par contrôle glycémique. La version en langue arabe a révélé une cohérence interne adéquate ( $\alpha = 0,70$ ) et une fiabilité fractionnée modérée ( $r = 0,65$ ). La validité par groupe connu a été confirmée par une association significative observée entre l'adhésion au traitement et le contrôle de la glycémie, avec une taille d'effet modérée ( $\phi_c = 0,34$ ). La version en langue arabe avait des propriétés psychométriques satisfaisantes et pourrait être utile pour la recherche sur le diabète et la pratique y afférente dans les pays arabes.

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## Introduction

Adherence to diabetes medications is essential for achieving better glycaemic control in patients with diabetes mellitus (1–3). Poor adherence has been associated with higher health-care expenditure (4) and so medication adherence is also important to reduce disease-related costs (5). Low adherence to diabetes medication is a particular concern in countries where the burden of diabetes is high, as in the case with many Arab nations. According to the International Diabetes Federation, the Middle East and North Africa, which is mostly comprises Arab countries, has the highest comparative prevalence of diabetes among adults compared with other regions (6). It is important therefore to have a valid measure of medication adherence that can be used in Arabic-language clinical settings in order to be able to assess which patients are poor adherers.

Several tools are available for measuring medication adherence. Among these are blood assay, electronic monitoring of medications containers, pill counts and self-reporting methods (7,8). The selection of any of these measures is determined by several factors. Some tools, such as blood assay, could be of limited utility, as they cannot be used for all medications (8). Moreover, other issues, such as feasibility and cost, could preclude the use of many sophisticated medication adherence measuring methods, such as blood assay and electronic monitoring (8). This is especially a concern in settings where such methods are unavailable, which is the case in many clinical facilities of several Arab countries. On the other hand, self-reporting measures are easy to use and affordable and they have been recommended for use in clinics (8). Nevertheless, among the available self-reporting measures, simplicity is an essential element to consider when choosing a self-reporting measure,

especially in some studies and in busy clinics (9).

Among the simple and the most commonly used self-reporting medication adherence measures is the 8-item Morisky Medication Adherence Scale (MMAS-8<sup>®</sup>) (10). This scale and was developed from the 4-item Morisky Medication Adherence Scale (MMAS-4) (11) and the Morisky, Green, Levine Adherence Scale (12). The original English-language MMAS-8 is a reliable and valid tool, and its psychometric assessments included testing for its reliability, concurrent and predictive validity (10) and its concordance with pharmacy dispensing data (13). It displayed satisfactory internal consistency reliability, with a Cronbach alpha coefficient of 0.83 (10). The original MMAS-8 showed a significant correlation with the original MMAS-4, which supports its concurrent validity, and its predictive validity was supported by testing the association between medication adherence as measured by the scale and several medication adherence-related criteria (10). The single dimension structure of the original MMAS-8 was supported using factor analysis, whereby all of its items loaded on 1 component, with a minimum factor loading of 0.425 (10). In addition, the concurrent and concordance validity of the original MMAS-8 were supported using pharmacy refill medication adherence data (13).

The MMAS-8 has been used widely for several different diseases—including diabetes (1,14,15), schizophrenia (16) and epilepsy (17,18)—and among different cultural groups. Several versions of the scale in different languages have been psychometrically evaluated, for example the Turkish (19), Urdu (20), Malaysian (21), Korean (22), Portuguese (23) and French (24) versions. All of these translated versions showed acceptable levels of reliability and validity. The scale has also been used among Arab populations for several disease groups. An Arabic

version of the MMAS-8 was used in Palestine to measure adherence to medication for diabetes (14,15) and epilepsy (17), and in Egypt to assess adherence to schizophrenia medication (16). More recently, the scale was used to assess medication adherence among a sample of patients with a mix of chronic diseases in Saudi Arabia (25). However, we could not locate any published validation study of the Arabic version of the MMAS-8 within an Arab population with type 2 diabetes.

This pilot study aimed to test the reliability and known-group validity of the Arabic version of the MMAS-8 specifically as a measure for diabetes medication adherence among type 2 diabetes mellitus patients in clinical settings.

## Methods

### Study design and settings

A pilot study was conducted between August and October 2013 in the National Centre for Diabetes and Endocrinology, Tripoli, Libya. The study was approved by the institutional medical ethics committee at Universiti Kebangsaan Malaysia Medical Centre, Kuala Lumpur, Malaysia, and the authorities in the Centre.

### Sampling

There is no universal recommendation for an ideal number of subjects to be recruited in pilot studies. A sample size of 100 or less could be considered in such studies (26). Accordingly, the sample size was set at 100 with an assumption of 25% non-response. Therefore, the target sample size for this study was 125 respondents.

A total of 125 patients were recruited consecutively by the investigator in the waiting area of the outpatient clinics. The eligibility criteria included being Libyan, aged 18 years and above, having type 2 diabetes mellitus for at least 1 year, being on diabetes medications rather than

diet control alone, able to read and write in Arabic, having no visual or cognitive impairment that interfered with the ability to independently complete the questionnaire, and willing to participate in the study. Pregnant diabetic women were also excluded because they are under a special management in terms of both medication and follow-up protocol. Very ill patients were also not eligible.

Prior to recruitment, a verbal briefing on the study was provided to all potential respondents and an information sheet was given to those who agreed to participate in the study. Participation in the study was voluntary and signed consent was obtained from each patient.

## Measures

The respondents completed a self-administered questionnaire that included 3 sections: sociodemographic data (age, sex, marital status, education level and employment status); disease profile (duration of diabetes, current diabetes medications and the most recent glycosylated haemoglobin (HbA1c) result, i.e. not older than 3 months); and the Arabic version of the MMAS-8. The self-reported HbA1c value was verified by the investigator who checked the follow-up records and the latest laboratory results brought by the respondent for the follow-up visit before the final collection of the questionnaires. To reduce the number of incomplete questionnaires, the investigator checked them before final collection.

The MMAS-8 scale consists of 8 items. Each of the first 7 items has 2 possible responses (yes/no), while the 8th item is answered with a 5-point Likert scale. The possible total medication adherence score ranges between 0 and 8, and the higher the score, the better the adherence level. A total score < 6 is considered low adherence, while a total score of  $\geq 6$  but < 8 indicates moderate

adherence, and a score of 8 indicates high adherence.

The Arabic version of the MMAS-8 scale was obtained with permission from the scale owner. This version was developed using a strict forward and backward translation protocol, whereby 2 pairs of linguistic experts performed the translation independently. The version is in modern standard Arabic language, which is the language used for reading and writing in Arab countries, including Libya.

## Validation of the scale

### Reliability assessment

Internal consistency reliability was tested using the Cronbach alpha coefficient, along with the corrected item total correlation. However, as alpha is sensitive to the number of items, a low alpha is frequently reported for short scales (27). Therefore, other consistency reliability statistics that were recommended as more appropriate for scales with few items were also assessed. These were the average inter-item correlation (27), and the split-half reliability using the Spearman–Brown coefficient; the latter was recommended as the most appropriate reliability measure for 2-item measures (28).

### Known-group validity

To examine the known-group validity of the questionnaire, the association between glycaemic control status and medication adherence as measured by the Arabic version of the MMAS-8 was tested using Pearson chi-squared test. The respondents were categorized into 3 medication adherence groups based on their total scores: low (score < 6), moderate (score  $\geq 6$ –< 8) and high adherers (score 8). Patients were categorized into 2 glycaemic control groups based on the American Diabetes Association recommendations of < 7% for the target HbA1c level (29): good control (HbA1c < 7%) and poor control (HbA1c  $\geq 7$ ). As a 2  $\times$  3 contiguous table was used, Cramer V statistic ( $\phi_c$ )

was used to quantify the effect size (30) of the association between medication adherence and glycaemic control.

### Diagnostic accuracy

The sensitivity and specificity and positive predictive value and negative predictive value of the Arabic version were assessed when the total MMAS-8 score of 6 was used as a cut-off point for dichotomizing patients into low and moderate-to-high adherers, as per the scale instructions.

## Statistical analysis

SPSS, version 22, was used to conduct the data analysis. Data cleaning and the required item reversing and standardization, as depicted in the MMAS-8 scoring instructions were carried out before proceeding to the main analysis. The 95% confidence intervals (CI) for sensitivity, specificity, positive predictive value and negative predictive value were computed using the *DAG-Stat* spreadsheet (31).

## Results

### Sample characteristics

Of the 125 distributed questionnaires, only 103 useable questionnaires were returned and were considered for the analysis, which gave the study a response rate of 82.4%. Both sexes were represented, with females comprising 68.9% of the sample. The mean age of the respondents was 52.7 (SD 8.6) years, and 80.6% of them were married. Out of all the respondents, 55.3% had primary education and 53.4% were housewives. The disease profile questions revealed that 32.0% of respondents had had diabetes for more than 10 years and 47.6% of them were on both oral hypoglycaemic agents plus insulin. The mean HbA1c level was 9.10% (SD 2.31%). Mean total medication adherence score was 5.25 (SD 2.01), and 56.3% of the respondents were low adherers (Table 1).

## Reliability assessment

The reliability of the Arabic version of the MMAS-8 was assessed using Cronbach alpha coefficient, average inter-item correlation and Spearman–Brown coefficient. The Arabic MMAS-8 version showed adequate internal consistency reliability ( $\alpha = 0.70$ ). All the corrected item total correlations were optimal (0.34–0.51), except for item 5; this item showed the lowest corrected item total correlation ( $r = 0.25$ ). However, deleting

this item did not appreciably improve the alpha value ( $\alpha = 0.71$ ) and so the item was retained. The version also displayed optimal average inter-item correlation ( $r = 0.25$ ) and a moderate split-half reliability as indicated by the Spearman–Brown coefficient ( $r = 0.65$ ) (Table 2).

## Known-group validity

Known-group validity was assessed by comparing the MMAS-8 scores of patients grouped by glycaemic control

status using the Pearson chi-squared test. Among 58 patients who were self-reported low adherers to medication, 55 (94.8%) had poorly controlled diabetes. The association between medication adherence and glycaemic control was found to be statistically significant ( $\chi^2 = 12.38, P = 0.002$ ). The effect size was moderate ( $\phi_c = 0.34$ ), and these findings support the known-group validity of the Arabic version MMAS-8 (Table 3).

## Diagnostic accuracy

The sensitivity, specificity, positive predictive value and negative predictive value of the Arabic MMAS-8 were assessed with patients dichotomized into low and moderate–high adherers at the cut-off score of 6. At this cut-off, the Arabic version MMAS-8 had sensitivity of 63.9% (95% CI: 52.8–74.0%), specificity of 82.3% (95% CI: 56.5–96.2%), positive predictive value of 94.8% (95% CI: 85.6–98.9%) and negative predictive value of 31.1% (95% CI: 18.1–46.6%) (Table 4).

## Discussion

The findings obtained from this study support the Arabic version of MMAS-8 as a reliable and valid measure for medication adherence in diabetes. All reliability measures were acceptable. The reported alpha coefficient was adequate and indeed was highly satisfactory when considering the sensitivity of the alpha statistic to the length of the scale (27). The alpha coefficient reported in this study is lower than that reported for the scale among a patients with a mix of different chronic diseases in a Saudi Arabian study (0.795) (25). Compared with other translated versions of the MMAS-8 that were evaluated as measures for medication adherence in diabetes, the reported alpha value in this study was higher than those reported for the Malaysian (0.657) (21), Korean (0.66) (22) and Thai (0.61) (32) versions. However, the alpha coefficient for the

**Table 1 Sociodemographic characteristics, diabetes profile and medication adherence of patients with diabetes ( $n = 103$ ) based on the 8-item Morisky Medication Adherence Scale**

Variable	Value	
<b>Age (years) [mean (SD)]</b>	52.7 (8.6)	
<b>Sex (no., %)</b>		
Female	71	68.9
Male	32	31.1
<b>Marital status (no., %)</b>		
Single	2	1.9
Married	83	80.6
Divorced	4	3.9
Widowed	14	13.6
<b>Education level (no., %)</b>		
Primary	57	55.3
Secondary	32	31.1
University/higher education	14	13.6
<b>Employment status (no., %)</b>		
Employed	36	35.0
Unemployed	12	11.7
Housewife	55	53.4
<b>Diabetes duration (years) (no., %)</b>		
< 5	38	36.9
5–10	32	31.1
> 10	33	32.0
<b>Diabetes medication (no., %)</b>		
Oral hypoglycaemic	31	30.1
Insulin	23	22.3
Oral hypoglycaemic + insulin	49	47.6
<b>HbA1c (%) [mean (SD)]</b>	9.10 (2.31)	
<b>Overall MMAS-8 score [mean (SD)]</b>	5.25 (2.01)	
<b>Medication adherence groups (No., %)</b>		
Low (score < 6)	58	56.3
Moderate (score $\geq 6$ –< 8)	35	34.0
High (score 8)	10	9.7

SD = standard deviation; HbA1c = glycosylated haemoglobin.

**Table 2 Reliability of the Arabic version of 8-item Morisky Medication Adherence Scale among patients with type 2 diabetes mellitus ( $n = 103$ ) in clinical settings in Libya**

Scale items	Corrected item total correlation ( $r$ )	Cronbach alpha ( $\alpha$ )	Average inter-item correlation ( $r$ )	Spearman-Brown correlation ( $r$ )
1	0.345	-	-	-
2	0.463	-	-	-
3	0.510	-	-	-
4	0.414	-	-	-
5	0.253 <sup>a</sup>	0.71 <sup>b</sup>	-	-
6	0.465	-	-	-
7	0.401	-	-	-
8	0.488	-	-	-
1-8	0.253-0.510	0.70	0.25	0.65

<sup>a</sup>Item with the least corrected item total correlation; <sup>b</sup> $\alpha$  if item 5 was deleted.

Arabic version in the current study was lower than that reported for the original scale among patients diagnosed with hypertension (0.83) (10). The Arabic version displayed an average inter-item correlation that falls within the optimal range (33), which reflects an adequate homogeneity of the items. Additionally, the Spearman-Brown coefficient result indicated moderate split-half reliability. Furthermore, all the items showed optimal corrected item total correlations except for item 5. This item asks if the respondent took the medications the day before. As this study was conducted in clinical settings, it was expected that a high proportion of the respondents would give a positive response to this item. This is because they knew in advance that they would be seen by their health-care provider on the next day and that blood tests might be requested to evaluate their blood glucose level. This

might be the reason for the relatively lower corrected item total correlation observed for this item.

The Arabic version was able to differentiate between diabetic patients with poor and good glycaemic control, which is known to be affected by medication adherence. This supported the known-group validity of the version. The reported association displayed a moderate effect size. This result was satisfactory because small and modest size effects had been frequently reported for behavioural factors (34). Similarly, known-group validity in the context of diabetes was also supported for other MMAS-8 translated versions such as the Malaysian (21) and Thai (32) versions.

The Arabic version displayed a sensitivity lower than that reported with the original English-language scale among respondents with hypertension (93%) (10). However, to some extent, the

reported sensitivity was comparable to the sensitivity reported among diabetics for the same cut-off point score with the Malaysian (77.6%) (21) and Korean (74%) (22) versions but was higher than that reported with the Thai version (51%) (32). The reported sensitivity reflects a reasonable ability of the Arabic version to correctly identify type 2 diabetes patients who are low adherers to their medications, and it is deemed satisfactory especially considering the simplicity of the scale as a short self-reporting measure. The reported specificity of the Arabic version among diabetes patients was higher than that reported with the original version among patients with hypertension (53%) (10) and it was also higher than the specificity reported for diabetes patients with the Malaysian (45.37%) (21), Korean (38.3%) (22), and Thai (64%) (32) versions. Moreover, our study showed that the Arabic version had a high positive predictive value at this cut-off point, but a low negative predictive value. These indices are deemed reasonable and lend support to the Arabic version as a suitable screening tool for poor medication adherence in clinical settings, especially in view of the other advantages of self-reporting, such as being easy and quick to apply, affordable and non-invasive.

This pilot study represents the first insight into the validity of the Arabic version of MMAS-8 as a measure of medication adherence in diabetes, and it provides evidence about several psychometric aspects of this self-administered measure. As the Arab countries are facing a high burden of

**Table 3 Known-group validity of the Arabic version of the 8-item Morisky Medication Adherence Scale ( $n = 103$ )**

Medication adherence group	Glycaemic control status				$\chi^2$	$P$ -value	$\phi_c$
	Poor (HbA1c $\geq 7\%$ )		Good (HbA1c $< 7\%$ )				
	No.	%	No.	%			
Low adherers (score $< 6$ )	55	94.8	3	5.2	12.383	0.002	0.34
Moderate adherers (score $\leq 6$ - $< 8$ )	24	68.6	11	31.4			
High adherers (score 8)	7	70.0	3	30.0			

HbA1c = glycosylated haemoglobin.

**Table 4 Sensitivity, specificity, and positive and negative predictive value of the Arabic version of the 8-item Morisky Medication Adherence Scale (MMAS-8) using the total score of 6 as a cut-off point**

Variable	Glycaemic control status			Diagnostic accuracy of the MMAS-8	
	Poor (HbA1c ≥ 7%)	Good (HbA1c < 7%)	Total	%	95% CI
	No.	No.	No.		
Medication adherence group <sup>a</sup>					
Low adherers (score < 6)	55	3	58	-	-
Moderate-to-high adherers (score ≥ 6)	31	14	45	-	-
Total	86	17	103	-	-
Sensitivity	-	-	-	63.9	52.8-74.0
Specificity	-	-	-	82.3	56.5-96.2
Positive predictive value	-	-	-	94.8	85.6-98.9
Negative predictive value	-	-	-	31.1	18.1-46.6

<sup>a</sup>Medication adherence groups dichotomized at total MMAS-8 score of 6.  
HbA1c = glycosylated haemoglobin; CI = confidence interval.

type 2 diabetes mellitus, the findings have important implications for diabetes care in these settings. This measure would help in providing valid data on medication adherence levels to be used in the planning of locally appropriate strategies to handle sub-optimal adherence. Clinically, measuring medication adherence with a sound tool would also help to identify patients who are in need of intervention.

The main weaknesses of the study were related to the methodology. The small sample size used in this pilot study might have influenced the results. The non-probability sampling might impose limitations on the generalizability of the findings. However, a large number of type 2 diabetes mellitus patients from Tripoli and its surroundings are being followed up in our Centre and the sample included a diverse group of patients. In addition, the demographic profile of the respondents corresponded to the epidemiological pattern of type 2 diabetes mellitus in Libya (35) in terms of age and sex. Other possible limitations include those related to self-reporting,

such as recall bias and over-reporting of medication adherence. Additionally, the interpretation of the study findings should consider that this study validated the Arabic version of the MMAS-8 as a self-administered tool rather than as an interview tool. Therefore, patients who could not complete the version independently for reasons of illiteracy or low visual acuity might need to be considered in further research that would evaluate the version as an interview tool. Besides, the results should also be viewed with the consideration that this study was done in a clinical facility and perhaps studies in non-clinical settings would produce different findings. Another limitation of this study is that, for logistic reasons, test-retest assessment of the time stability of the version was not included.

### Conclusion

The Arabic version of MMAS-8 displayed satisfactory reliability and validity as a self-administered medication

adherence measure for patients with type 2 diabetes mellitus. This finding lends support to its use in clinical settings with Arab-speaking populations. Therefore, the findings are believed to have implications on research and clinical practice in several Arab countries which have been facing a high burden of diabetes mellitus, especially when other sophisticated medication adherence measures are not feasible.

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Use of the MMAS<sup>®</sup> is protected by United States copyright laws. Permission for use is required. A license agreement is available from Donald E. Morisky, Department of Community Health Sciences, UCLA School of Public Health, 650 Charles E. Young Drive South, Los Angeles, CA 90095-1772.

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