Original Article

Psychometric Properties of the Simplified Chinese Version of the Malaysian Medication Adherence Scale (C-MALMAS) on Elderly Patients

Yee Wei Shim [a, b], Siew Siang Chua [a, c *], Donald E. Morisky [d]

[a] Department of Pharmacy, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia, [b] Department of Pharmacy, Duchess of Kent Hospital, Sandakan, Sabah, Malaysia, [c] School of Pharmacy, Faculty of Health and Medical Sciences, Taylor's University, Lakeside Campus, Subang Jaya, Selangor, Malaysia, [d] Department of Community Health Sciences, UCLA Fielding School of Public Health, Los Angeles, CA, USA

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SUMMARY

Background: Poor medication adherence is a concern among elderly patients. One of the convenient measures of medication adherence is by using a validated instrument. Therefore, this study aimed to examine the psychometric properties of the Simplified Chinese version of the Malaysian Medication Adherence Scale (C-MALMAS) for assessing medication adherence of elderly patients.
Methods: The C-MALMAS consists of 8 items which measure one domain. It was translated into the Simplified Chinese version and validated on a convenience sample of 100 elderly outpatients in Malaysia. Internal consistency of the C-MALMAS was evaluated based on Cronbach's alpha value. A retest was conducted a month later to assess its stable reliability. Validity was assessed using convergent validity by comparing C-MALMAS to the Simplified Chinese translation of the 8-item Morisky Medication Adherence Scale (MMAS-8) and concurrent validity was confirmed by comparing the medication adherence determined using C-MALMAS with that using pill count.
Results: The C-MALMAS has an acceptable internal consistency, with Cronbach's alpha of 0.586 and a test-retest correlation of 0.405 ($p < 0.001$), indicating fair correlation. A good correlation between the C-MALMAS and MMAS-8 was found (Spearman's rho = 0.717; $p < 0.001$). A significant association between medication adherence based on the C-MALMAS and pill count was observed. The C-MALMAS has a sensitivity and specificity of 94.4% and 33.3%, respectively, with positive and negative predictive values of 67.3% and 80.0%, respectively.
Conclusion: C-MALMAS is a reliable and valid instrument for measuring medication adherence of elderly patients, especially when a specific recall period is required.

1. Introduction

'Adherence' has been defined as "the extent to which a person's behavior - taking medications, following diet, and/or executing lifestyles changes, corresponds with agreed recommendation from a health care provider".[1] The term 'adherence' takes into consideration a patient's agreement to the recommendations by his/her health care provider and emphasizes on an active role of the patient in his/her own health as well as good communication between the patient and his/her health care provider.

A systematic review identified a few methods for assessing medication adherence among elderly patients.[2] Tools used to measure medication adherence can be divided broadly into traditional methods, disease and drug-based adherence assessment methods, and technological aids assessment methods. None of the methods can be considered as the gold standard and hence, a combination of assessment methods is recommended while monitoring of clinical outcomes may complement the use of these assessment methods.[2,3]

Medication adherence rate among elderly patients ranged from 26 to 59%.[4] In addition, 50% of elderly patients took their

* Corresponding author. Department of Pharmacy, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia.
E-mail address: chua_ss@hotmail.com (S.S. Chua).

medications wrongly.[2] Enhancing medication adherence has been recognized as a strategy to better manage chronic health problems effectively.[1] Low medication adherence among elderly patients contributes to an increase in morbidity and mortality as well as health care cost and wastage of resources.[5] Therefore, interventions to improve medication adherence among elderly patients should be prioritized.[6]

The most widely used instrument to assess medication adherence is the 4-items Morisky Medication Adherence Scale (MMAS-4)[7] which has been expanded to an 8-item scale (MMAS-8)[8] and validated with the medication possession ratio using pharmacy claim data.[9] The English version of the Malaysian Medication Adherence Scale (MALMAS) has been validated.[10] Although both of the medication adherence scales are quite similar, both have its usefulness in certain scenario as the MALMAS has a specific recall period of one month. Since Malaysia is a multiracial country with Malays, Chinese and Indians as the three major ethnic groups, a validated Simplified Chinese translation of the MALMAS will help to assess the medication adherence of a wider sector of its population. Therefore, the present study was conducted to assess the psychometric properties of the Simplified Chinese version of the MALMAS (C-MALMAS) in Malaysia.

2. Materials and methods

A cross sectional study was conducted on elderly patients who obtained their medications from the outpatient pharmacy of a tertiary hospital in East Malaysia. Written informed consent was obtained from all participants included in the study. This study was approved by the Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia (NMRR-12-958-13020).

The original English version of the MALMAS was translated to Simplified Chinese version in accordance with the international guidelines.[11] Permission to use the Simplified Chinese translation of MMAS-8 was granted through a licensure agreement. The original English version of MALMAS was forward translated to the Simplified Chinese version by two native speakers of the Chinese language who were also fluent in English. This was done independently to produce two copies of the Simplified Chinese version. The two copies of the Simplified Chinese version was combined into a third copy after discussion between the two translators. This third copy was back translated independently by another two persons who were also fluent in Chinese and English to produce two copies of the English version. The two researchers then matched the two copies of the English versions with the original English version of MALMAS. Any inconsistency was resolved through discussion between the translators and the researchers. Changes were made as required to produce the final harmonized version of the Simplified Chinese version of the MALMAS (C-MALMAS).

Like the English version of the MALMAS, the Simplified Chinese version also consists of 8 items which measure one domain. Medication adherence is assessed based on the scores obtained, as described for that of the English version.[10]

Participants were interviewed using the C-MALMAS and the Simplified Chinese translation of MMAS-8. Patients who were 65 years old or above, able to communicate in Mandarin, were using at least one medication and willing to see the pharmacist for follow-up at the stipulated time frame, were requested to participate in the study. Patients who had problems in communication, and those whose medications were supervised by their caregivers or other health care personnel were excluded.

Face validity was obtained through a pilot study on five elderly patients to determine whether they could understand the C-MALMAS. Face-to-face interview was conducted with the two

medication adherence scales (MALMAS and MMAS-8). For every ten participants, five participants were selected using a random table to fill the C-MALMAS first, followed by the Simplified Chinese translation of MMAS-8 while the other five participants followed the reverse order. Participants were requested not to use their previous supply of medications throughout the study period. An extra one week of medications was supplied to all participants to cater for any delay in attending their scheduled appointment with the researcher. Participants were reminded to bring back all their medications when they returned to the pharmacy to refill their medications within one month. A retest of both the instruments was carried out 2−4 weeks after the first administration to determine the stable reliability of the instruments and also to conduct the pill count.

The required sample size for validation and reliability study is the number of items in the instrument multiple by five. Since the C-MALMAS consists of eight items, therefore the minimum sample size required will be 40 (8 items times 5). However, a minimum of 50 subjects has been recommended as adequate.[12,13] Therefore, at least 60 participants should be recruited to account for a 20% dropout during the study.

All data were analyzed using the Statistical Package for Social Sciences (SPSS) version 20 (IBM Corp., Armonk, NY, USA). Internal consistency of the instruments was analyzed using Cronbach's alpha values while the test-retest reliability of the instruments was evaluated using the McNemar's test for dichotomous variables and Wilcoxon Signed-Rank test for the 5-Likert-like response in the C-MALMAS and MMAS-8. Convergent validity of the C-MALMAS was verified by comparing with the Simplified Chinese translation of the MMAS-8 using Wilcoxon Signed-Rank Test and Spearman's rho where correlation were interpreted as followed: little or no correlation (0−0.25), fair correlation (0.25−0.5), moderate to good correlation (0.5−0.75) and very good to excellent correlation (>0.75).[14] Levels of medication adherence were categorized as low, medium or high adherence based on the total score which ranged from 0 to 8. In addition, the MALMAS was subdivided into adherence (medium and high adherence) and non-adherence (low adherence) and the percentages of participants in each category were compared with that of MMAS-8 using Pearson's chi square test.

Concurrent validity of the C-MALMAS was confirmed by comparing the levels of medication adherence determined using the C-MALMAS with that using pill count. This was further verified using Spearman's rho between the scores obtained with the C-MALMAS and with the pill count. In terms of pill count, participants were classified as: poor low when at least one drug is 0−39% or ≥160%; partial low when at least one drug is 40−79% or 120−159%; and excellent when pill count of all the drugs are between 80 and 119%.[15] Participants with excellent pill count were considered as adherence while those with poor low and partial low pill count were considered as non-adherence. Association between the category of adherence based on C-MALMAS and that obtained from pill count was assessed using Pearson chi square test. A p value of less than 0.05 was considered as statistically significant.

The sensitivity of the C-MALMAS to accurately detect patients with good medication adherence and specificity of the instrument to detect patients with poor medication adherence was assessed. This association can also be represented by calculating "adherence using pill count" and "non-adherence using pill count". True positive (TP) would be adherence using pill count and using the C-MALMAS while true negative (TN) would be non-adherence using both methods. False positives (FP) indicate adherence using C-MALMAS but non-adherence using pill count while false negatives (FN) mean non-adherence using C-MALMAS but adherence using pill count. Positive predictive value (PPV) predicts how likely the

patient is adherent to his/her medications as assessed using C-MALMAS when he/she has a good pill count while negative predictive value (NPV) predicts how likely the patient is non-adherence as assessed using C-MALMAS when he/she has a poor pill count.[16]

3. Results

A total of 100 participants were recruited into this study but only 65 completed the test-retest and 59 had the pill count. The socio-demographic characteristics of the participants are presented in Table 1.

3.1. Psychometric properties of the Simplified Chinese version of MALMAS

3.1.1. Reliability analysis

The Cronbach's alpha coefficients for the Simplified Chinese version of MALMAS and MMAS-8 were 0.586 and 0.617, respectively. However, exclusion of items 4 and 7 in the C-MALMAS increased its Cronbach's alpha to 0.591 and 0.599, respectively (Table 2). If item 7 in the Simplified Chinese translation of MMAS-8 were excluded, the Cronbach's alpha increased to 0.629 (Table 2).

The corrected item-total correlations for most items in the C-MALMAS exceeded 0.2, except for items 4 and 7 while only item 7 in the Simplified Chinese translation of MMAS-8 had a corrected item-total correlations of less than 0.2 (Table 2).

All the eight items and the total scores for both instruments showed stable reliability from the test-retest results ($p > 0.05$) [Table 2]. In addition, the Spearman's rho for the C-MALMAS was 0.405 ($p < 0.001$), indicating fair correlation between the first and second test. For the Simplified Chinese version of MMAS-8, the Spearman's rho was 0.588 ($p < 0.001$), indicating moderate to good correlation between the first and second test.

3.1.2. Convergent validity

The total adherence score of both the C-MALMAS and the MMAS-8 did not fulfill the normal distribution criteria ($p < 0.001$).

Table 1
Characteristics of participants.

Characteristics	Total sample N = 100
Age (years)	
Mean (SD)	73.04 (5.44)
Gender n (%)	
Male	60 (60.0)
Female	40 (40.0)
Educational level n (%)	
No formal education	18 (18.0)
Primary	54 (54.0)
Secondary	21 (21.0)
Diploma/Tertiary/Post-graduate degree	7 (7.0)
Employment status n (%)	
Not employed	86 (86)
Employed	14 (14)
Number of medications	
Median (IQR)	5.00 (5.00)
MMAS score[a]	
Median (IQR)	8.00 (1.81)
MALMAS score	
Median (IQR)	7.75 (1.25)
Pill count data (%)	
Median (IQR)	98.21 (8.83)

SD, standard deviation; IQR, interquartile range.
[a] Use of the ©MMAS is protected by US and International copyright laws. Permission for use is required. A license agreement is available from: Donald E. Morisky, MMAS Research (MORISKY) 16636, 159th Place SE, Renton WA 98058, dmorisky@gmail.com.

There was no statistically significant difference in the average adherence score of participants using either instrument (Table 3). Using Spearman's correlation test, the C-MALMAS showed moderate to good correlation with the Simplified Chinese translation of MMAS-8 ($r = 0.717$; $p < 0.001$). The prevalence of medication adherence was not associated with whether the C-MALMAS or the Simplified Chinese translation of MMAS-8 was used (43.0% and 56.0%, respectively, $p = 0.146$) [Table 3].

3.1.3. Concurrent validity

The adherence rates for participants using C-MALMAS and pill count were 83.1 and 59.3%, respectively. Of the 59 participants, 67.3% who were categorized as adherent based on the C-MALMAS scores were also categorized as adherent by using pill count while 80% of participants who were categorized as not adherent based on the C-MALMAS scores were also categorized as partial low and low adherence using pill count (Table 4). Fisher's exact test showed that the assessment of medication adherence using the C-MALMAS was associated with that based on pill count ($p = 0.011$). In addition, the C-MALMAS scores showed fair correlation with that of the pill counts ($r = 0.474$; $p < 0.001$) using the Spearman's correlation test.

3.1.4. Sensitivity and specificity

A cross tabulation of dichotomous values between medication adherence assessed using the C-MALMAS and that using pill count was generated to show the sensitivity and specificity of the C-MALMAS (Table 4). The sensitivity of the C-MALMAS in determining those who adhered to their medications and have good pill count data was 94.4% and the specificity of the C-MALMAS in determining those who did not adhere to their medications and have poor pill count was 33.3%. The positive and negative predictive values were 67.3% and 80.0%, respectively.

4. Discussion

This study established the psychometric properties of the Simplified Chinese version of MALMAS. These were similar to the validated Simplified Chinese translation of MMAS-8. The C-MALMAS has an acceptable internal consistency and stable reliability. In addition, the concurrent validity of the C-MALMAS has been verified using pill count. Therefore, the C-MALMAS is a reliable and valid instrument for measuring medication adherence of elderly patients, with high sensitivity and moderate specificity.

Both the C-MALMAS and the Simplified Chinese translation of MMAS-8 have Cronbach's alpha coefficients of more than 0.5 and hence, were considered to have acceptable internal consistency.[17] The coefficient of the C-MALMAS would increase slightly if the items 4 and 7 were excluded but these were retained since the Cronbach's alpha coefficient did not improve much and also the instrument has only a total of 8 items. These results are similar to that of a previous study on the English version of the MALMAS[10] where none of the items was excluded.

The C-MALMAS and the Simplified Chinese translation of MMAS-8 also achieved stable reliability as the test-retest results showed fair and moderate to good correlation (0.405 and 0.588, respectively with both $p < 0.001$). This is also similar to the English version of both the instruments.[18]

The proportion of participants who adhered to their medications was not associated with whether C-MALMAS or MMAS-8 was used (Table 3). This means that the two instruments produced similar results. Additionally, a significant moderate to good correlation was found between the two instruments. These results are again similar to that of the English version of MALMAS[10] and other

Table 2
Reliability analysis of the MALMAS and MMAS-8.

Item number	Corrected item-Total correlation		Cronbach's alpha if item deleted		Test-Retest reliability McNemar test/ Wilcoxon Signed Ranks test[a] p value	
	MALMAS (n = 100)	MMAS-8 (n = 100)	MALMAS (n = 100)	MMAS-8 (n = 100)	MALMAS (n = 65)	MMAS-8 (n = 65)
1 for MALMAS and 8 for MMAS-8	0.491	0.281	0.530	0.609	0.910 (−0.113[a])	0.102 (−1.633[a])
2	0.348	0.558	0.543	0.491	0.629	0.791
3	0.426	0.216	0.503	0.614	1.000	0.508
4	0.184[b]	0.213	0.591[c]	0.610	0.109	1.000
5	0.409	0.494	0.522	0.523	1.000	0.727
6	0.367	0.220	0.540	0.608	0.250	1.000
7	0.076[b]	0.071[b]	0.599[c]	0.629[c]	N/A	1.000
8 for MALMAS and 1 for MMAS-8	0.205	0.462	0.577	0.534	1.000	0.549
Total score					0.435 (−0.781[a])	0.515 (−0.652[a])

[a] z value obtained from Wilcoxon Signed Ranks test.
[b] Corrected item-total correlation < 0.2.
[c] Increase in Cronbach's alpha value if item was deleted.

Table 3
Comparison between the Simplified Chinese version of MALMAS and the Simplified Chinese translation of MMAS-8.

Adherence status (n = 100)	MALMAS [n (%)]	MMAS [n (%)]	χ^2/ z value	p value
High adherence (scores = 8)	43 (43.0)	56 (56.0)	3.855	0.146
Medium adherence (6 to < 8)	40 (40.0)	28 (28.0)		
Low adherence (0 to < 6)	17 (17.0)	16 (16.0)		
High adherence (scores = 8)	43 (43.0)	56 (56.0)	3.38	0.066
Medium and low adherence (scores < 8)	57 (57.0)	44 (44.0)		
High & medium adherence (scores = 6 to 8)	83 (83.0)	84 (84.0)	0.036	0.849
Low adherence (scores < 6)	17 (17.0)	16 (16.0)		
Mean total scores (SD) [Median]	7.06 (1.20) [7.75]	7.09 (1.26) [8.00]	−0.656[a]	0.512

SD, standard deviation.
[a] z value was obtained using the Wilcoxon Signed-Rank Test.

Table 4
Sensitivity and specificity of the MALMAS.

Categories of medication adherence	Pill count data (n = 59)		Positive & negative predictive value
	Non-adherence (Low to partial low)	Adherence (Excellent)	
Medium & high adherence (Adherence score ≥ 6) [n (%)]	16 (32.7) [FP]	33 (67.3) [TP]	**Positive PV** TP/(TP + FP) 67.3%
Low adherence (Adherence score < 6) [n (%)]	8 (80.0) [TN]	2 (20.0) [FN]	**Negative PV** TN/(TN + FN) 80%
Sensitivity & specificity	**Specificity** TN/(TN + FP) 33.3%	**Sensitivity** TP/(TP + FN) 94.4%	

PV, Predictive value; TP, True positive; TN, True negative; FP, False positive; FN, False negative.

studies which assess medication adherence using the MMAS-8.[19,20] This further confirms the convergent validity of the Simplified Chinese version of MALMAS. The main difference between C-MALMAS and the Simplified Chinese translation of MMAS-8 is that the C-MALMAS specifies a recall period of one month and hence, more appropriate for studies which aim to compare medication adherence between two different scenarios or for comparison between studies. The Simplified Chinese translation of MMAS-8 should be used for measuring the general adherence behavior of patients when a specific recall period is not necessary or not appropriate.

Significant association was observed between the scores and adherence levels of participants using the C-MALMAS, and that using pill count data ($p < 0.001$ and $p = 0.011$, respectively). This confirms the concurrent validity of the Simplified Chinese version of MALMAS.

The C-MALMAS was considered as accurate since it has a high number of true positives and true negatives compared to the number of false positive and false negatives.[16] The sensitivity of the

C-MALMAS in identifying those who were adherent to their medications and also had good pill count data was 94.4% and its specificity in identifying participants who were non-adherent to their medication and also had poor pill count data was 33.3%. This indicates that the C-MALMAS is sensitive in assessing adherence to medication but not as specific in assessing non-adherence to medication. This property of the C-MALMAS is as expected since over-reporting of medication adherence is common due to social desirability.

4.1. Strengths and limitations

The validated C-MALMAS can now be used on patients who can understand Chinese. C-MALMAS specifies a one-month recall period of medication adherence and hence, it can be used to compare medication adherence within a specific time frame. Without a specific recall period, comparison of medication adherence between studies or assessment of the effect of an intervention on medication adherence may not be possible. However, the

limitations of this study was that patients were recruited from only one hospital and therefore, the results might not be representative of other Chinese speaking population in different regions. In addition, like any other retrospective studies, recall bias of participants could not be ruled out and hence, the pill count was used to further validate the study results. Pill count was another indirect method of assessing medication adherence as direct methods such as using biologic markers was not feasible since elderly patients could have a variety of chronic diseases and hence, the use of a specific marker was not possible.

4.2. Conclusion

The psychometric properties of the Simplified Chinese version of MALMAS are similar to that of the English version while its concurrent validity showed significant association between medication adherence assessed using C-MALMAS and that using pill count data. In addition, the Simplified Chinese version of MALMAS has high sensitivity for identifying those who were adherent to their medications but it is not as specific for identifying those who were non-adherent to their medications. Therefore, this study demonstrated that the Simplified Chinese version of MALMAS is a reliable and valid instrument for assessing medication adherence of elderly patients in Malaysia who can communicate in Chinese.

Conflicts of interest

The authors declare that there is no conflict of interest. Morisky receives an honorarium for use of the copyrighted MMAS scales.

Acknowledgements

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