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RESEARCH ARTICLE

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Validation of the Kazakh-language version of the 8-item Morisky Medication Adherence Scale in patients with arterial hypertension

Gulnaz Nuskabayeva[a], Kanatzhan Kemelbekov[b], Dilbar Aidarbekova[a], Yerbolat Saruarov[a], Nursultan Nurdinov[a], Kumissay Babayeva[a], Ugilzhan Tatykayeva[a], Elmira Iskandirova[a], Dinara Nemetova[a], Philip Morisky[c], Ainash Oshibayeva[a] and Karlygash Sadykova[a]

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ABSTRACT

Background: The effectiveness of pharmacological therapies relies not only on the intrinsic efficacy of medicines, but also medication adherence, the extent to which patients follow their prescribed regimens. Patients with chronic conditions, such as hypertension, are at an increased risk of exhibiting poor medication adherence. Therefore, identifying patients with poor medication adherence is an important aspect of treatment success.

Research design and methods: The present study aims to translate and adapt the Morisky Medication Adherence Scale (MMAS-8), a self-reporting questionnaire to assess patients' adherence to prescribed therapy.

Results: The study validated the translated questionnaire and assessed its psychometric properties among a cohort of 400 patients with arterial hypertension in Turkistan region in southern Kazakhstan. The findings of the present study show that the Kazakh version of the MMAS-8 possesses high validity, reliability, and internal consistency, thereby confirming its appropriateness as a reliable tool for assessing medication adherence among patients with arterial hypertension in Kazakhstan.

Conclusion: The psychometric properties of the Kazakh adaptation were comparable to those of the original English version and other validated non- English versions of the MMAS-8.

PLAIN LANGUAGE SUMMARY

Medicines can only work well if patients take them as prescribed. This is especially important for people with long-term conditions like high blood pressure, where missing doses can lead to serious health problems. In this study, researchers translated and adapted a widely used questionnaire called the Morisky Medication Adherence Scale (MMAS-8) into Kazakh language, and tested it with 400 patients with high blood pressure. The results showed that the Kazakh translated questionnaire is comparable to the original English version in its accuracy and reliability. Therefore, the Kazakh translated version can be confidently used in Kazakhstan to measure how closely patients with high blood pressure follow their medication plans.

ARTICLE HIGHLIGHTS

- Medication adherence ensures the effectiveness of pharmacological therapies.
- Patients with chronic conditions such as hypertension are likely to have issues with medication adherence.
- The study aimed to translate and culturally adapt the Morisky Medication Adherence Scale (MMAS-8) in Kazakhstan.
- A group of 400 patients with arterial hypertension from the Turkistan region in the southern part of the country participated in this study.
- The Kazakh version of the MMAS-8 demonstrated high validity, reliability, and internal consistency.
- The results confirms the suitability of the Kazakh MMAS-8, as a robust tool for assessing medication adherence, comparable to the original English as well as other validated versions.

ARTICLE HISTORY

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KEYWORDS

Medication adherence; arterial hypertension; Morisky scale (MMAS-8); Kazakh-language validation; psychometric evaluation

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1. Introduction

Medication adherence, the extent to which the patient follows and strictly adhere to medical instructions including medication timing, dosage and frequency [1]. Patients considered adherent to medications when they take prescribed agents at doses and times recommended by a healthcare provider and agreed to by the patient [2]. Despite advances in pharmacotherapy, suboptimal adherence remains widespread and contributes to disease progression, increased hospitalizations, and premature death [3].

Chronic diseases such as hypertension, type two diabetes mellitus, cardiovascular disease, asthma, and chronic kidney disease represent a major global health burden. Effective management of these conditions relies heavily on long-term pharmacotherapy. However, evidence consistently shows that as high as 50% of patients do not take their medications as prescribed, and this percentage can be much greater for chronic disease patients [4]. For example, a cross sectional study of nearly 200 patients with hypertension in Jordan showed the average of nonadherence rate of approximately 85%, spread over medication taking behavior 89.8%, missing medical appointments at 85%, and sodium intake reduction at 80.5% [5]. Similarly, a study from Turkey showed that nearly 60% of patients with iron deficiency anemia identified as non-adherents to their medication [6].

While certain populations are at greater risk of non-adherence, such as those with low health literacy, multiple chronic conditions, or financial barriers, Aljofan et al., 2023 summed the factors into five different categories including; healthcare system-related factors, patient-related factors, socioeconomic-related factors, therapy-related factors, and disease-related factors [2].

Poor medication adherence is associated with increased morbidity and mortality, preventable disease complications, and higher healthcare expenditures. In the United States, non-adherence is responsible for an estimated 125,000 annual deaths and up to 10% of hospitalizations [7,8]. Hence, to improve patient's adherence, we must understand their medication-taking behavior, beliefs about medicines, and the obstacle that they encounter [9]. Therefore, addressing the underlying causes of non-adherence is essential for achieving optimal therapeutic outcomes and improving population health.

One of the most popular tools to determine medication adherence in clinical practice is Morisky Medication Adherence Scale (MMAS), self-report questionnaire designed to measure a patient's adherence to prescribed medications, particularly for patients with chronic diseases such as hypertension, diabetes, asthma, and HIV [10]. The first version of the scale proposed in 1986, and later improved in 2008 [11]. The MMAS-8 scale is a modified version with better psychometric characteristics, which takes into account the behavioral characteristics of patients to judge the level of compliance, and additional questions to identify influencing factors that affect patient's medication adherence [12].

However, there is a lack of questionnaires for assessing medication adherence in Kazakhstan, a Central Asian country with nearly 20 million people, where cultural and systemic factors significantly influence medication adherence. For example, a number of Kazakhstani prefer the use of alternative treatments such as folk remedies to prescribed regimens [13]. Another important factor is due to the differences within the bilingual healthcare environment (Kazakh and Russian) that could lead to/or contribute to misunderstanding of treatment instructions. Therefore, the current study aims to adapt the MMAS-8 questionnaire from its current English version into Kazakh language, the most commonly spoken language in the Southern region. The study will validate the questionnaire, and evaluate its psychometric properties using a group of patients with arterial hypertension in Turkistan region in south Kazakhstan.

2. Materials and methods

2.1. Ethical approval

The study design was reviewed and approved by the Human Ethics Committee at the Khodja Ahmed Yasawi International Kazakh-Turkish University in Turkistan (Approval №30- 30/05/2024). Participants received a written and oral explanation of the study, its aims and process. Those who consented to participate provided a signed voluntary consent form. All data collection and consent forms kept in a secure setting, only available to the principal investigator in accordance with the Ethical Committee requirement.

2.2. Calculating sample size

The sample size required at an absolute error estimated at 5% and 95% confidence level was 368 participants. In addition, the attrition rate (i.e., to consider non-respondents) was 5%. Therefore, the required number of participants was 387.

2.3. Eight-item Morisky Medication Adherence Scale (MMAS-8)

This self-report scale consists of 7 items with a "yes 'or ' no" response and 1 item with a 5-point Likert scale. MMAS-8 scores range from 0 to 8. A score below 6 indicates low adherence, a score from 6 < 8 indicates medium adherence and 8 indicates high adherence [14–16].

2.4. Setting and design

The study conducted in the Clinical and Diagnostic Center of the Khoja Akhmet Yassawi International Kazakh-Turkish University in Turkestan city. Participants recruited through convenience sampling, consisting of individuals meeting the inclusion criteria, readily accessible and consented to take part in the study.

2.5. Translation of MMAS-8

The 8-item Morisky Medication Adherence Scale (MMAS-8) questionnaire translated from English into Kazakh, the local language and mother tongue of the participants. A standardized translation and back-to-back- translation procedure was developed. Two qualified and independent English-Kazakh translators translated the original MMAS-8 into Kazakh language without mutual consultation. A third translator performed reverse translation from Kazakh to English, to ensure accuracy. The original and back-to-back-translated versions then reviewed and evaluated by the team members. A few disagreement on the language used in the Kazakh version was solved by consultation between the team members and the translators. All involved approved the final Kazakh version of MMAS-8 scale. Figure 1 shows the approach and stages of this study.

2.6. Study validation and reproducibility

The approved version of Kazakh language MMAS-8 was validated according to Wild et al., with a pilot run using a group of ten randomly selected individuals [15]. The results of the pilot study were not used in the final analysis of the study. In order to test the reproducibility of the Kazakh version of the MMAS-8, a group of one hundred participants diagnosed with arterial hypertension was recruited. Those who participated in the reproducibility study received the Kazakh version of the MMAS-8, and then followed up two weeks later with a Google Form questionnaire containing the electronic version of MMAS-8 survey.

2.7. Study setting

2.7.1. Study population (inclusion/exclusion)

Inclusion: We only included patients diagnosed with arterial hypertension of both genders (irrespective of diseases stage), and who were ≥18 years of age at the time of surveying. Exclusion: Patients with non- arterial hypertension, and those who were less than 18 years old were excluded from the study. Patients who were unwilling or unable to provide informed consents, and those who declined participation at any stage, were excluded as well.

2.8. Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) for Windows version 25.0 (SPSS, Chicago, IL, USA). Descriptive analysis was used for socio-demographic data and participants' responses to the MMAS-8 questionnaire. Reliability and internal consistency were statistically evaluated with Cronbach's Alpha statistical analysis. The Cronbach's α coefficient was suggested to be 0.70 as an acceptable coefficient.

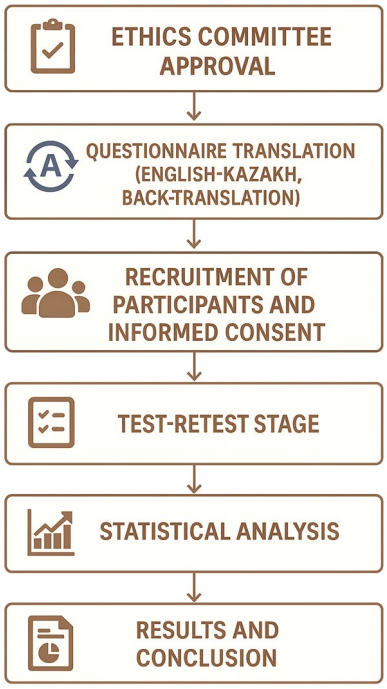

Figure 1. Stages of the study. The diagram shows the approach and the processes of each stage of the study after the conception of the idea and starting with the ethical approval, study design, translation process, and validation process.

2.9. Confirmatory and exploratory factor analyses

To examine the structural validity of the Kazakh version of the MMAS-8, we conducted a confirmatory factor analysis (CFA) and exploratory factor analysis (EFA) to identify factors unique to Kazakh patients with arterial hypertension. The CFA was used to assess fit of the scale in a one-factor model, as described in Harmon et al. [17]. Root mean square error of approximation (RMSEA), non-normed fit index [NNFI], and the comparative fit index (CFI) were used to assess fit of the model. NNFI and CFI values > 0.9 as well as RMSEA < 0.05 indicate item is good fit. EFA and varimax rotation were applied and factors with latent roots of more than 1, considered as a significant contributor.

2.10. Data availability

The data that support the findings of this study are available on request from the corresponding author, [A.O.]. The data are not publicly available as they contain information that could compromise the privacy of research participants.

3. Results

3.1. Demographic data

A total of 460 questionnaires were distributed to patients diagnosed with arterial hypertension, but only 400 were completed given an overall response rate of approximately 87%. The characteristics of the studied population is shown in Table 1. Out of the total 400 respondents, 274 (68.5%) were females, with a majority of 398 resided in Turkistan city (98%). The age range of participants in years is 27–78, with an average age of 54 years, and more than half of the participants (51.75%) reported to have undergraduate degrees, and nearly a quarter have higher than bachelor (24.75%). A total of 234 participants (58.5%) have a full time job, and a quarter of the participants are retired at the time of surveying. The majority of participants 385 do not smoke and more than 300 do not drink alcohol, equating to approximately 89.5% and 76%, respectively.

Table 1. The characteristics of the target population.

Gender	Number of respondents	Percentage (%)		
Male	126			
Female	274			
Residence	Number of respondents	Percentage (%)		
In the city	392	98		
In a village	7	1.75		
Other option	1	0.25		
Marital status	Number of respondents	Percentage (%)		
Married	230			
Not married	18			
Divorced	22			
Widowed	30			
Age	Number	Mean	Std dev	Min	Max
	400	54.08	12.175	27	78
Age group	Number of respondents	Percentage (%)		
Less than 44 years old	120	30		
45-59 years old	146	36.5		
60-74 years old	128	32		
Older than 74 years old	6	1.5		
Education	Number of respondents	Percentage (%)		
Primary school	4	1		
Secondary school	78	19.5		
Middle specialized education	12	3		
Bachelor	207	51.75		
Higher than Bachelor	99	24.75		
Employment	Number of respondents	Percentage (%)		
Not employed	46	11.5		
Fully employed	234	58.5		
Partially employed	18	4.5		
Student/pupil	2	0.5		
Pensioner/retired	100	25		
Smoking	Number of respondents	Percentage (%)		
No	358	89.5		
Half a pack or less daily	26	6.5		
Half a pack to a pack daily	12	3		
More than one pack daily	4	1		
Alcohol	Number of respondents	Percentage (%)		
No	304	76		
Less than once a week	50	12.5		
1–2 times per week	26	6.5		
3–4 times per week	15	3.75		
5–7 times per week	5	1.25		

The table above is showing the characteristics of the 400 participants. The majority of the participants were females with approximately ratio of two females to every participating male. More than half of the participants have a bachelor degree and a full time job.

3.2. Evaluating the relative contribution of MMAS-8 items in adherence assessments

The mean scores, standard deviations, and item-total correlation coefficients for each of the eight items in the MMAS-8, along with the overall Cronbach's alpha coefficient assessing internal consistency are shown in Table 2. Among the investigated items, question number 8 of the scale "*How often do you have difficulty remembering to take all your medications?*" that demonstrated the highest ratio of item to total answers correlation ($r = 0.72$) and a Cronbach's alpha of 0.84.

This indicates a strong association with the overall adherence measure, and confirms the significant contribution to the internal consistency of the scale. In contrast, question five *"Did you take your medicine yesterday?"* showed the lowest correlation with the overall score and yielded a Cronbach's alpha coefficient below 0.70. However, the reliability of the scale remained within the acceptable levels, with a Cronbach's alpha of value of 0.76, indicating that the internal consistency of the instrument was not adversely affected by the inclusion of this item.

3.3. Validation and reproducibility of the MMAS-8 questionnaire

Administrating the MMAS-8 questionnaire in a subsample of 100 participants, and then re- administering it, after a two-week interval, allowed us to test the reliability that was assessed using intraclass correlations (ICC), for item-to-total correlations, using Analysis of Variance (ANOVA). The ICC value was - 0.99, suggesting an internal consistency and reliability of the MMAS-8 test items (Table 3). This indicates a high degree of reliability

Table 2. Item-to-total correlation of the MMAS-8 questionnaire.

Items	Mean (SD)	Item: Total correlation	Cronbach's coefficient
1. Do you sometimes forget to take your medicine?	0.62 (0.49)	0.66	0.79
2. 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 medicine?	0.47 (0.50)	0.70	0.82
3. Have you ever cut back or stopped taking your medication without telling your doctor, because you felt worse when you took it?	0.37 (0.48)	0.64	0.78
4. When you travel or leave home, do you sometimes forget to bring along your medication?	0.33 (0.47)	0.59	0.76
5. Did you take your medicine yesterday?	0.45 (0.50)	0.40	0.57
6. When you feel like your illness is under control, do you sometimes stop taking your medicine?	0.48 (0.50)	0.64	0.77
7. Taking medication everyday is a real inconvenience for some people. Do you ever fell hassled about sticking to your treatment plan?	0.25 (0.43)	0.62	0.77
8. How often do you have difficulty remembering to take all your medications?	1.88 (1.07)	0.72	0.84

Mean scores, standard deviations, and item-total correlation coefficients for the eight items of the Morisky Medication Adherence Scale (MMAS-8). The overall Cronbach's alpha coefficient is presented to assess internal consistency.

Table 3. Validation of the MMAS-8 questionnaire (n – 100).

Test-retest status	Mean (SD)	Intraclass correlation coefficient
MMAS-8 (1st time)	5.59 (2.67)	0.99
MMAS-8 (two-weeks interval)	5.67 (2.72)	

Test and retest reliability of the Morisky Medication Adherence Scale (MMAS-8) using a subsample of 100 participants. Reliability was assessed using intraclass correlation coefficients (ICC) over a two-week interval.

between full primary testing and retesting of the scale overtime. Confirming the suitability of the tested items in measuring the same underlying concept.

3.4. Confirmatory factor analysis

CFA for the one-factor model of the MMAS-8 showed poor fit indices (RMSEA = 0.079, NNFI = 0.901, and CFI = 0.781), which indicate possible discrepancy between the hypothesized and observed values. The EFA showed two factors with latent roots of more than 1, with factor loadings between the eight MMAS items and the two factors revealed the following: factor 1 comprised items 1, 2, 5, and 8, referring to forget to take medications; and factor 2 included item 7, indicating the difficulty of taking medications on a daily basis.

4. Discussion

There are a number of methods used to assess medication adherence, of which patient self-reported measures continue to be the most widely utilized approach, provided the individual accurately recalls their actions and is motivated to report them truthfully [18]. One of these methods is MMAS-8, a self-report questionnaire designed to measure the extent to which a patient follows their prescribed medication regimen. Hence, the current study aimed to develop a Kazakh version of the MMAS- 8 for evaluating self-reported medication adherence in patients with arterial hypertension. To our knowledge, this is the first study in Kazakhstan that attempted to validate and test the reliability of a Kazakh-language version of MMAS-8, as well as examining its factorial structure using CFA.

Standardized instruments, such as the Morisky Medication Adherence Scale, must undergo a rigorous process of forward and backward translation, expert review, and pre-testing to preserve the conceptual meaning of each item. In the present study, independent professional translators and clinical researchers were involved

in this process to ensure the questionnaire is not only linguistically accurate but also culturally appropriate, reflecting the beliefs, healthcare practices, and literacy levels of the target population.

We tested this by a pilot study involving ten randomly selected individuals who not only accepted the questionnaires, but raised no concerns of issues. Proper adaptation enhances respondents' understanding of the questions, improves response accuracy, and increases the overall acceptability and usability of the tool in clinical and research settings [16]. After translating the MMAS-8 from its English form into Persian version, Iranpour and colleagues reported a high acceptance rate among participating patients [19]. Similarly, Laghousi et al., who validated the questionnaire using a Persian-speaking diabetic patients group, reported high acceptance and cultural sensitivity of questionnaire [20]. Culturally sensitive instruments enable accurate assessment of medication adherence behaviors and support the development of tailored interventions to improve health outcomes in diverse settings [16,20].

The results of investigating the psychometric properties of the Kazakh version of the MMAS-8 showed high internal consistency (Cronbach's $\alpha = 0.76$), confirming the validity of the tool for assessing the level of adherence to treatment in patients with arterial hypertension for Kazakh speaking patients. This is in agreement with Morisky et al., which reported a similar Cronbach's α value of 0.83, using the original version of the MMAS-8 with more than 1300 hypertension patients [12]. The present results are also in agreement with the results of non-English versions of the MMAS-8. For example, the use of a Malaysian language-translated version of the eight-item MMAS using a sample of patients with diabetes showed an acceptable Cronbach's α value. Similarly, Ashur et al. tested the Arabic version of MMAS-8 and showed an adequate internal consistency of $\alpha = 0.70$ [21].

However, several MMAS-8 validation studies showed a much lower internal consistencies, including the European Portuguese version of the MMAS-8 ($\alpha = 0.6$) [22], Koran validation study ($\alpha = 0.56$) [23], and French validation study ($\alpha = 0.54$) [24]. Whilst Cronbach's Alpha values of 50–59 are considered poor values, they still, somewhat acceptable [25]. The low internal consistency values are likely due to the fact that the MMAS-8 measurement encompasses distinct domains testing medication-taking behavior, rather than adherence behavior [26,27].

In this study, correlation analysis revealed significant correlation coefficient between individual questions and total score (between 0.40–0.72). These values reflect differing levels of association, with certain questions showing a stronger link to the overall adherence score than others [28,29].

Intriguingly, removing an item increased the range of correlation coefficients to 0.57–0.84, indicating a high level of homogeneity and homogeneity of the Kazakh version of the MMAS-8 questionnaire. The correlation coefficients between individual items on the MMAS-8 and the total score generally range from 0.230 to 0.658, thus the higher the values the higher the correlation [11]. This strongly suggest that the Kazakh version of the MMAS-8 is an acceptable tool for measuring medication adherence among patients with arterial hypertension in Kazakhstan.

Furthermore, to evaluate changes over time, a reliability test of the Kazakh MMAS-8 version was assessed using the intraclass correlation coefficient (ICC) by administering the survey twice, separated by a two-week interval, and comparing the scores from the first administration with those from the second. The results showed an ICC value of 0.99 ($p < 0.001$), indicating a high degree of reliability between the two testing periods. This finding is comparable to that of Muntner et al., which tested the reliability of MMAS-8 using more than 200 hypertension patients [30]. The participants in this study completed the questionnaire twice with a time difference of 14–22 days. The standard error of the mean for change in MMAS-8 scores per patient was 0.81, a value corresponds to a minimally detectable change of 1.98 points, slightly less than the cutoff value of more than two, which might indicate real changes in antihypertensive medication adherence [30,31].

4.1. Limitations

However, there are a number of important limitations in the use of MMAS-8 and other self- reporting questionnaires such as recall bias or overstating adherence, where participants may forget how often they missed doses over the past month, or overstate their adherence to appear compliant, respectively. While the study conducted in one Kazakhstani region using convenient sampling, which may not be generalized to the broader Kazakhstani population, we involved a statistically acceptable number of participants to provide a reflective picture and reliable statistical analyses.

To improve the generalizability of findings, recruitment strategies such as stratified or cluster sampling, random selection within defined populations or multi-center recruitment can improve the sample's diversity

and representativeness. Thus, reducing the risk of selection bias and providing a more accurate reflection of the target population. Therefore, future research should aim to expand their findings through conducting multi-center investigations across the different regions in Kazakhstan, including urban and rural areas. Similarly, to minimize reporting bias and improve measurement accuracy, objective indicators such as electronic monitoring data, and pharmacy refill records could be analyzed along with self-reporting data, producing more robust and generalizable insights into adherence behaviors and their influencing factors.

5. Conclusion

The present study showed high validity, reliability and internal consistency of the Kazakh version of MMAS-8, confirming its suitability as a validated tool for assessing the level of medication adherence for patients with arterial hypertension in Kazakhstan. The Kazakh version of MMAS-8 showed acceptable properties comparable with the original English-language as well as other non- English versions of MMAS-8 questionnaire. The current findings warrant further investigation of the Kazakh-language version of MMAS-8 for other chronic disease patients in Kazakhstan. Given its cultural acceptance and ease of use by patients with arterial hypertension, this questionnaire might be a useful tool in clinical settings to assess medication adherence. It may enable the identification of patients with poor medication adherence, and help in providing early interventions to improve chronic disease management and health outcomes.

Acknowledgments

MMAS™ used with permission: www.adherence.cc.

Author contributions

GN, KK, DA, YS, NN, KB, UT, EI, and DN contributed to data collection and curation. AO and KS conceived and designed the study. GN, DA, and YS performed the statistical analyses. AO, KS, and PM provided methodological guidance and interpretation of findings. GN, NN, and KB drafted the initial manuscript. AO, KS, and PM critically revised the manuscript for important intellectual content. All authors reviewed and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

Disclosure statement

Philip Morisky holds the intellectual property rights to the MMAS (Morisky Medication Adherence Scales) and oversees its academic and commercial use. This role has not influenced his contributions to the research, analysis, or interpretation of the findings presented in this publication.

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