ORIGINAL ARTICLE

The Modification and Validation of the Medication Compliance Questionnaire (MCQ) for the Assessment of Adherence to Antiretroviral Therapy (ART)

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ABSTRACT

INTRODUCTION: Anti-retroviral therapy (ART) significantly improves the prognosis of human immunodeficiency virus (HIV) infection. Yet long-term and complex regimens often lead to non-adherence. Maintaining at least 95% adherence is crucial for effective ART and thus preventing drug resistance. The Medication Compliance Questionnaire (MCQ) has been used for adherence assessment in antihypertensive treatment, with an 80% cut-off level. This study aimed to modify and validate the MCQ for assessing adherence to ART. **MATERIALS AND METHODS:** The MCQ underwent modification with the incorporation of a new rating scale and scoring method. A pilot study was conducted at the Infectious Disease Clinic, Hospital Raja Perempuan Zainab II, Kelantan. Inclusion criteria were adults living with HIV (PLHIV), on ART for at least two months and who can communicate in Malay. Fisher's Exact test was used to determine validity, sensitivity, and specificity. Cronbach's alpha and intra-class correlation coefficients were used to evaluate reliability, with significance set at $p < 0.05$. **RESULTS:** A total of 60 PLHIV adults participated in this pilot study. Viral load served as the validity criterion for the modified MCQ, showing a significant association with adherence ($p=0.018$). Sensitivity and specificity values were 100.0% and 79.5%, respectively. Cronbach's alpha coefficients for drug-taking and drug-stopping behaviour domains were 0.65 and 0.90, respectively. **CONCLUSION:** The modified MCQ is a valid and reliable tool for assessing adherence to ART, demonstrating high sensitivity and adequate specificity. It is suitable for use in clinical practice to improve medication therapy management for PLHIV.

Keywords
Medication Compliance Questionnaire, adherence assessment, questionnaire validation, anti-retroviral therapy

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INTRODUCTION

Anti-retroviral therapy (ART) significantly improves the prognosis of human immunodeficiency virus (HIV) infection; however, long-term treatment and maintenance of strict adherence to treatment is required.[1] The key factor for the success of treatment is good medication adherence, defined as the degree to which a patient follows the treatment plan agreed upon with their healthcare provider.[2] Adherence is often quantified as a percentage, reflecting the proportion of doses taken as prescribed.[3] In contrast to other chronic diseases, HIV infection necessitates a high adherence rate of approximately 95% to ensure effective viral suppression, owing to the rapid replication and high mutation rate of the virus.[4] Maintaining a minimum adherence rate of at least 95% is crucial for suppressing HIV viral load to below 400 copies/mL in most individuals.[5] Suboptimal adherences can lead to sub-therapeutic drug levels, compromising treatment efficacy and potentially resulting in increased viral load, decreased CD4 count, a higher risk of HIV transmission, and an elevated risk of developing resistance to ART drugs.[6] Unfortunately, only one-third of people living with HIV (PLHIV) adhere to their medication as prescribed.[7] In Nigeria, the non-adherence rate to ART was reported to be as high as 40%.[8] Even when patients fully understand the consequences of non-adherence, adherence rates remain suboptimal.[2,4]

Non-adherence to ART regimens can stem from the complexities of the treatment, which often requires taking more than two dozen pills, tablets, or capsules daily. Additionally, the necessity for complete adherence and the long-term nature of the treatment contribute to this challenge.[5] Therefore, there is a need to develop a convenient tool for monitoring ART adherence. Assessing adherence behaviour accurately in PLHIV is essential in ensuring treatment planning is effective and efficient. A review of the literature reported many methods used to measure adherence.[9] Direct measurements of adherence include drug assays of blood or urine,[10] surrogate laboratory markers,[11] and directly observing patients receiving the medications.[12] Indirect adherence measurements include the self-report adherence questionnaire,[13] pill count,[14] electronic monitoring devices,[15] and review of prescription records or secondary database analysis.[16]

Currently, there is no standard reference method that can be advocated to evaluate adherence because each method has its own advantages and limitations.[12] One of the most accurate methods of measuring adherence is by direct measures. However, these are costly.[17] Indirect measures, such as self-report adherence questionnaire, provides a practical and flexible method for adherence assessment and provides a unique chance to identify patient concerns. The self-report method is used widely due to its simplicity, relatively inexpensive and implementation ease in a patient's follow-up.[18] However, it is often linked with adherence overestimation and its outcomes vary compared to direct measures such as therapeutic drug monitoring.[19] Several self-reported adherence questionnaires exist, although they were not tailored specifically for HIV infection. Examples of these questionnaires are Morisky Medication Adherence Scale,[20] Patient Medication Adherence Questionnaire,[21], Brief Medication Questionnaire[22], Malaysia Medication Adherence Assessment Tool (MyMAAT)[23] and Medication Compliance Questionnaire (MCQ).[24]

Most of the Questionnaires mentioned required license for usage and not available in languages commonly used in Malaysia. The MCQ is available in Malay, English, Chinese and Tamil languages and can be completed within 10 minutes. Therefore, it was chosen as a tool in assessing adherence in this study.

The MCQ serves as a tool to assess adherence from the viewpoint of the patients. MCQ was originally developed and validated with hypertensive patients at the Family Medicine Clinic, Hospital Universiti Sains Malaysia, Kelantan. This questionnaire employs a five-level Likert scale comprising ten items focusing on drug-taking and drug-stopping behaviours.[24] Additionally, the MCQ has been utilized to evaluate adherence among patients with ischaemic heart disease[25] and cancer[26] in Malaysia.

In 2003, the World Health Organization (WHO) outlined adherence to long-term therapies as a behaviour influenced by five dimensions of obstacles. These dimensions include barriers associated with the healthcare team or system, the therapy itself, the patient's condition, the patient themselves, and socioeconomic factors.[2] Instances of therapy-related barriers encompass side effects and the complexity of drug regimens.[27] Condition-related barriers often involve the severity of symptoms, levels of disability (physical, psychological, social, and vocational), disease progression rate, severity, and access to effective treatments.[2] Patient-related barriers notably include forgetfulness, low self-efficacy, and misconceptions about diseases and medications.[27]

Many of these barriers fall within the assessment domains of drug-taking behaviour and drug-stopping behaviour in the MCQ. Barriers to adherence in ART are similarly multi-dimensional.[28] If healthcare providers restrict adherence assessments to only one or two barrier types, they risk overlooking other patient concerns that, while reported less frequently, can significantly impact adherence. Hence, the MCQ was selected as the tool for assessing adherence in this study. MCQ is an instrument with good validity and reliability.[24] However, the results may differ in other diseases and populations.[29] Therefore, the objective of this study is to modify and revalidate the MCQ to be used in adherence assessment of PLHIV.

MATERIALS AND METHODS

The Instrument

The MCQ is available in both Malay and English. It consists of ten items concerning drug-taking behaviour (Questions 1 to 7) and drug-stopping behaviour (Questions 8 to 10). A five-level Likert scale from 1 (never) to 5 (very frequent) is used. Internal consistency reliabilities (Cronbach's alpha) were 0.67 and 0.84, and test-retest single measure intraclass correlation coefficients were 0.78 and 0.93, respectively, for each domain.[30] Unfortunately, the content validity index was not included in the study. The MCQ can be completed in 10 minutes.

Modification of MCQ

To assess the adherence levels among participants, we established a common cut-off point of 80% using a five-level Likert scale, which was deemed appropriate for capturing varying degrees of adherence. The scale was defined as follows: 1 (never) corresponding to 20%, 2 (seldom) to 40%, 3 (sometimes) to 60%, 4 (frequent) to 80%, and 5 (very frequent) to 100%. This structure allows for a straightforward categorization of adherence levels.

To measure a more stringent cut-off point of 95%, we recognized the need for modifications to the instrument. Specifically, we employed a continuous measurement scale, which allows for finer distinction of adherence scoring. This involved converting the Likert scale responses into a 0–100-point scale, enabling a precise assessment of adherence percentages. For example, rather than being limited to discrete categories, participants' responses could now reflect a continuum of adherence levels. This approach facilitates a more accurate identification of adherence rates, particularly for those achieving close to the 95% threshold, thereby enhancing the instrument's sensitivity and specificity in evaluating adherence to HIV therapy. Through these modifications, we aimed to capture the full range of adherence behaviour, allowing for a comprehensive analysis of the relationship between adherence and treatment outcomes.

Pilot Study to Evaluate Validity and Reliability of MCQ Participants and Study Setting

The cross-sectional investigation took place at the Infectious Disease Clinic within Hospital Raja Perempuan Zainab II, a publicly funded tertiary hospital situated in the state of Kelantan, East Malaysia. To ensure adequate representation, an estimated target sample size of 60 People Living with HIV (PLHIV) was determined, factoring in a 20% anticipated drop-out rate, based on an item-to-subject ratio of 1:5.[31] Inclusion criteria comprised individuals diagnosed with HIV infection, receiving antiretroviral therapy for a minimum of two months, aged 18 years or older, and proficient in communicating in the Malay language.

Patients were contacted by the investigator during their routine follow-up appointments at the Infectious Disease Clinic using convenience sampling. They were briefed about the aim of the study, procedures and invited to sign a written informed consent form upon agreeing to participate. To maintain privacy and focus, participants completed the modified MCQ in a counselling room. The investigator gathered demographic and clinical information of the participants. The medical records were reviewed for viral load and CD4 counts, and demographic and clinical information were collected on the same day by the investigators (Figure 1).

The modified MCQ (as shown in Figure 2) was given twice to assess the test-retest reliability, with a two-week interval between the initial and subsequent sessions to minimize recall bias. This duration was considered adequate to prevent alterations that might influence responses, yet not too brief as to facilitate recollection of previous answers.[32]

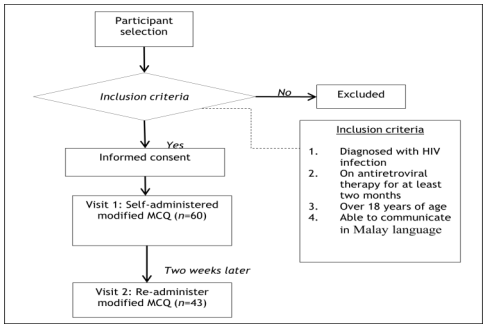


Figure 1: Flow chart of the modified MCQ validation study

Statistical Analysis

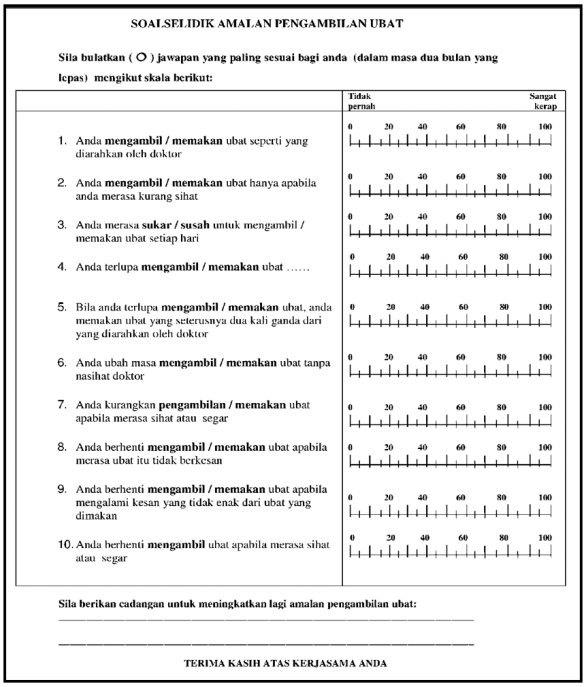
Descriptive statistics were utilized to depict the demographic and disease characteristics of the participants alongside their medication adherence scores. For continuous variables, means and standard deviations (SD) were computed, while categorical variables were expressed as frequencies (n) and percentages. Validity was assessed by examining the association between compliance and subjects' viral load using Fisher's Exact test, with a significance level set at $p<0.05$. Sensitivity (true positive) and specificity (true negative) values of the adjusted MCQ were also determined. Sensitivity gauged the test's accuracy in identifying poor virologic control among non-adherent patients, while specificity assessed its accuracy in identifying good virologic control among adherent patients.[33]

Internal consistency was assessed by Cronbach's alpha to evaluate correlations between the items in the factor. A Cronbach's alpha of above 0.9 was considered excellent, while values above 0.7 and 0.6 were noted as good and acceptable, respectively.[34] Single measure ICC was used to assess test–retest reliability. The ICC measured the stability of the items or agreement between modified scores, with 0 to 0.2 being considered poor agreement, 0.3 to 0.4 as fair agreement, 0.5 to 0.6 as moderate agreement, 0.7 to 0.8 as strong agreement, and above 0.8 as almost perfect agreement.[35]

RESULTS

Descriptive statistics were employed to describe the demographic and disease characteristics of the subjects. Means and standard deviations (SD) were calculated for continuous variables, while frequencies (n) and percentages were used for categorical variables.

The association between compliance and subjects' viral load was determined using Fisher's Exact test. A significant *p*-value of 0.018 was obtained, indicating a meaningful relationship.



SOALSELIDIK AMALAN PENGAMBILAN UBAT

Sila bulatkan (○) jawapan yang paling sesuai bagi anda (dalam masa dua bulan yang lepas) mengikut skala berikut:

	Tidak pernah — Sangat kerap
1. Anda **mengambil / memakan** ubat seperti yang diarahkan oleh doktor	0 20 40 60 80 100
2. Anda **mengambil / memakan** ubat hanya apabila anda merasa kurang sihat	0 20 40 60 80 100
3. Anda merasa **sukar / susah** untuk mengambil / memakan ubat setiap hari	0 20 40 60 80 100
4. Anda terlupa **mengambil / memakan** ubat ……	0 20 40 60 80 100
5. Bila anda terlupa **mengambil / memakan** ubat, anda memakan ubat yang seterusnya dua kali ganda dari yang diarahkan oleh doktor	0 20 40 60 80 100
6. Anda ubah masa **mengambil / memakan** ubat tanpa nasihat doktor	0 20 40 60 80 100
7. Anda kurangkan **pengambilan / memakan** ubat apabila merasa sihat atau segar	0 20 40 60 80 100
8. Anda berhenti **mengambil / memakan** ubat apabila merasa ubat itu tidak berkesan	0 20 40 60 80 100
9. Anda berhenti **mengambil / memakan** ubat apabila mengalami kesan yang tidak enak dari ubat yang dimakan	0 20 40 60 80 100
10. Anda berhenti **mengambil** ubat apabila merasa sihat atau segar	0 20 40 60 80 100

Sila berikan cadangan untuk meningkatkan lagi amalan pengambilan ubat:

TERIMA KASIH ATAS KERJASAMA ANDA

Figure 2: The modified MCQ

The sensitivity and specificity values of the modified MCQ were generated. The sensitivity was found to be 100.0%, indicating the instrument's ability to predict poor virologic control correctly in non-adherent patients. The specificity was determined to be 79.5%, reflecting the instrument's ability to correctly predict good virologic control in adherent patients. Internal consistency was assessed using Cronbach's alpha. Coefficients of 0.65 for the drug-taking behaviour domain and 0.90 for the drug-stopping behaviour domain were obtained. Correlations of corrected item-total ranged from 0.46 to 0.85 for the drug-taking behaviour domain and from 0.70 to 0.89 for the drug-stopping behaviour domain.

Test-retest reliability was assessed using single measure intra-class correlation coefficients (ICCs). Values of 0.87 for the drug-taking behaviour domain and 0.95 for the drug-stopping behaviour domain were observed, indicating strong to almost perfect agreement.

Overall, the modified MCQ was shown to be a valid and reliable instrument for assessing adherence to ART, with high sensitivity and adequate specificity. Therefore, it is deemed suitable for use in clinical practice to enhance medication therapy management for PLHIV.

Demographic and clinical characteristic of the participants in the pilot study

A total of 60 PLHIV participants took part in the pilot study. Majority were Malays with the mean age of 37.0 years and almost equal numbers of males and females. Majority of the patients (n=56, 93.0%) were adherent to highly active antiretroviral therapy (HAART) with a mean score of 99.3. The mean CD4 count was 278.0 cell/mm^3 with a range of 2 to 796 cell/mm^3. The mean viral load was 18,007.7 copies/ml and 28.3% (n=17) participants had an undetectable viral load (Table I).

Table I: The demographic and clinical characteristic of the participants in the pilot study (n=60)

Characteristics	n	%	Mean	SD
Age (years)			37.0	6.7
Gender				
Male	31	51.7		
Female	29	48.3		
Ethnicity				
Malay	59	98.3		
Chinese	1	1.7		
Modified MCQ score			99.3	1.9
Adherent	56	93.0		
Non-adherent	4	7.0		
Liver function				
ALP (IU/L)			122.9	80.4
AST (IU/L)			39.8	31.5
ALT (IU/L)			37.5	37.5
Renal function				
Creatinine clearance (ml/min)			78.3	21.8
CD4 count (cell/mm^3)			278.0	174.2
Viral load (copies/ml)			18,007.7	61,741.7
0* to 50	27	62.8		
51 to 400	4	9.3		
401 to 2,000	2	4.7		
More than 2,000	10	23.26		

*0 means undetectable with limit of detection of 20 copies/ml
(17 participants had undetectable viral)

Validity testing of the modified instrument

Virological outcome or viral load was used as the criterion for validity analysis. In this investigation, a participant was categorized as non-adherent if their most recent viral load (obtained during the pilot study's three-month timeframe) exceeded 400 copies/mL.[36] Out of the 60 patients, only 43 (71.7%) underwent viral load testing within this timeframe. Using Fisher's exact test, there was a significant association between the adherence and viral load (p=0.018) (Table II).

Table II: Association between adherence measured by the modified MCQ and virological outcome (viral load) (n=60)

Adherence	Viral load (copies/mL) n (%)		Total (n)	p-value
	400 or less	More than 400		
Adherent	31 (100.0)	8 (66.7)	4	**0.018**
Non-adherent	0 (0.0)	4 (33.3)	39	
Total (n)	31	12	43	

Fisher's exact test
Viral load of 400 or less indicated good control
Viral load of more than 400 indicated poor control

Sensitivity and specificity analysis of the modified Instrument

From the analysis, the findings indicated sensitivity (true positive) and specificity (true negative) values of 100.0% and 79.5%, respectively, for the modified MCQ (Table III).

Table III: The sensitivity and specificity of the modified MCQ

Viral load (copies/mL)	Adherent (%)	Non-adherent (%)
400 or less	79.5	0
More than 400	20.5	100
Sensitivity & specificity	Sensitivity 100%	Specificity 79.5%

Reliability analysis of the modified instrument

Internal consistency

The modified MCQ demonstrated varying levels of internal consistency across its domains. The Cronbach's alpha for the Drug Taking Behaviour domain (Questions 1 to 7) was 0.65, while the Drug Stopping Behaviour domain (Questions 8 to 10) showed a high Cronbach's alpha of 0.90. Notably, if Question 3 were removed, the Cronbach's alpha for the Drug Taking Behaviour domain would increase to 0.82. However, Question 3 was retained in the final version of the MCQ due to its significant contribution to the construct.

The corrected item-total correlations ranged from 0.46 to 0.85 for the Drug Taking Behaviour domain and from 0.70 to 0.89 for the Drug Stopping Behaviour domain (see Table IV). These correlations indicate how well each question aligns with the overall domain score, with higher values (generally above 0.3) suggesting meaningful contributions to the construct being measured.

For the Drug Taking Behaviour domain, Questions 1 and 2 both exhibited high mean scores (99.7) and low standard deviations (1.81), along with strong corrected item-total correlations of 0.85. Removing these questions would decrease the overall alpha to 0.59, highlighting their positive contribution to the reliability of the instrument. Question 3 had the highest corrected item-total correlation at 0.91, and its removal would lower the alpha to 0.82, underscoring its importance. Questions 4 and 5 demonstrated moderate correlations and would not significantly impact overall reliability if deleted, while Questions 6 and 7 showed strong correlations (0.80 and 0.81), positively contributing to the domain's reliability.

In the Drug Stopping Behaviour domain, Question 8 had a high mean score (99.7) and low variability (SD=1.81) but a lower corrected item-total correlation of 0.70. Removing it would result in a Cronbach's alpha of 1.00, suggesting it may not fit well with the other items. Conversely, Questions 9 and 10 exhibited high mean scores and strong corrected item-total correlations (0.89), indicating their critical role in maintaining the reliability of the scale; their removal would decrease the alpha to 0.80.

Overall, this analysis illustrates the reliability of each question within the domains related to drug adherence. It highlights which questions contribute positively to the overall construct and identifies items that may require further consideration for refinement or removal to enhance the overall reliability of the questionnaire.

Table IV: Cronbach's alpha value of each question in each domain

Domain	Mean	SD	Corrected item-total correlation	Cronbach's alpha if item deleted
Drug taking behaviour				
Question 1	99.7	1.81	0.85	0.59
Question 2	99.7	1.81	0.85	0.59
Question 3	96.3	12.94	0.91	0.82
Question 4	98.9	3.07	0.46	0.61
Question 5	99.7	1.81	0.72	0.60
Question 6	99.8	1.29	0.80	0.62
Question 7	99.9	0.65	0.81	0.64
Drug stopping behaviour				
Question 8	99.7	1.81	0.70	1.00
Question 9	99.8	1.30	0.89	0.80
Question 10	99.8	1.30	0.89	0.80

Test-retest reliability

Although all participants agreed for a two-week test-retest reliability analysis, only 43 of them turned-out to complete the MCQ questionnaire. The ICC value for drug taking behaviour domain was 0.87 (0.78, 0.93) with *p*-value <0.001. The ICC value for drug stopping behaviour was 0.95 (0.95, 0.99) with *p*-value <0.001. The ICC of 0.87 for drug taking behaviour indicates a strong reliability, meaning that the modified MCQ consistently measures the drug-taking behaviour of PLHIV over time. The narrow confidence interval (0.78, 0.93) supports the precision of this reliability estimate.

The ICC of 0.95 for drug stopping behaviour indicates an excellent reliability, suggesting that the modified MCQ is very consistent in measuring the drug-stopping behaviour of PLHIV. The extremely narrow confidence interval (0.95, 0.99) further confirms the precision and robustness of this estimate. Overall, the high ICC values and their statistical significance demonstrate that the modified MCQ is a reliable instrument for assessing medication adherence behaviours in both domains.

DISCUSSION AND CONCLUSION

Modification of the Instrument

The initial MCQ employed a Likert scale to evaluate adherence among hypertensive patients. A Likert scale consists of a sequence of discrete terms or statements, allowing patients to select the response that best matches their state or experience. The original MCQ utilized a five-level Likert scale, spanning from 1 to 5, with 'never' at one end and 'very frequent' at the other. Scores formulated with negative wording were reversed, and all scores were transformed to a 0 to 100% scale with intervals of 20%. This standardized scale effectively gauged adherence in hypertensive patients, where achieving a minimum total score of 80% signified consistent compliance with 'frequent' and 'very frequent' adherence across all questionnaire items.[30]

However, in the context of HIV infection, a 95% adherence rate is widely cited as essential to keep HIV load inhibition below 400 copies/mL.[19] Therefore, the original MCQ's five-level Likert scale was modified to assess a 95% adherence score in HIV patients. Negatively worded scores were reversed, and all scores were converted to a 0 to 100% scale.

In this study, the scale was modified to a continuous rating scale ranging from 0 (very unlikely) to 100 (very likely). This continuous numerical scale allowed patients to choose the value that best described their state or experience. The ends of the scale were anchored with descriptive words, such as 'very unlikely' or 'very likely'.[37] For content validation, the modified scale was reviewed and deemed appropriate by the original MCQ author. The new rating scale allowed PLHIV to place a mark at the appropriate position on a line that runs from 0 to 100, offering more options and potentially more accurate responses.[38] Since the modification only involved

the scale and scoring method, the validation was also applicable to the English version.

In this study, a high adherence rate (93%) to HAART was observed using the modified MCQ. The result was comparable to the reported adherence rates among PLHIV in Uganda (88-93%).[39] However, recent studies in Ethiopia revealed high rates of poor adherence, such as 71.8% in North-Eastern Ethiopia[40] and 66.3% in Eastern Ethiopia.[41] The adherence rate in this study was slightly higher than those in Thailand (82-85%)[42] but higher than the 68% reported in Asia by the TREAT Asia Studies to Evaluate Resistance Monitoring.[43]

According to the Malaysian guidelines for managing adult HIV infection with antiretroviral therapy,[44] patients start with vitamins to evaluate adherence behaviour before initiating HAART. Medication counselling and education were provided by trained pharmacists in the Medication Therapy Adherence Clinic for Retroviral Disease program, which consists of pre-HAART, initiating HAART, and follow-up HAART counselling.[45] Regular educational sessions and on-site counselling at clinics probably contributed to the remarkable adherence rate observed in this study.

Validation Testing and Reliability Analysis of the Modified Instrument

The link between adherence and HAART effectiveness was determined for criterion validity of the modified MCQ. The criterion used for this analysis was the virological outcome, which has been previously established in other adherence studies. [46,47] Adherence was defined as achieving a score of at least 95% on the modified MCQ, while effectiveness was defined as a viral load of fewer than 400 copies/ml within a three-month assessment period.

Criterion validity was assessed in a sample of 43 participants (71.7%) who had available viral load reports. Our findings demonstrated a positive association between adherence, as measured by the modified MCQ, and virological outcomes. Specifically, 100% of adherent patients achieved good virological outcomes, while none of the non-adherent patients did. This significant correlation reinforces the validity of the modified MCQ and aligns with previous research.[13,47]

Sensitivity and specificity of the modified MCQ were evaluated. Sensitivity was defined as the ability to accurately predict poor virological outcomes in non-adherent patients, and specificity as the ability to accurately predict good virological outcomes in adherent patients.[33] The sensitivity of the modified MCQ was 100%, and the specificity was 79.5%, indicating it was a sensitive and specific instrument for assessing adherence to ART.[48]

Reliability was assessed by internal consistency and test-retest analysis. Internal consistency, measured using Cronbach's alpha, showed coefficients of 0.65 for drug-taking behaviour and 0.90 for drug-stopping behaviour domains, consistent with the original MCQ.[30] High Cronbach's alpha values indicate good internal consistency, although values above 0.9 may suggest item redundancy.[50]

Test-retest reliability was assessed using single measure ICC, which was 0.87 and 0.95 for each domain, indicating excellent stability and reliability of the modified MCQ. These results were better than those reported by[30], demonstrating the modified MCQ's stability in the PLHIV population.

STUDY LIMITATIONS

This study had a few limitations. Firstly, most respondents were Malays, not representing the heterogeneous communities of Malaysia. Secondly, recall bias might have occurred during test-retest reliability assessment. If the time interval between test administrations was short, respondents might remember their previous responses, leading to artificially inflated correlations.

The modified MCQ was demonstrated to be a valid and reliable instrument for assessing adherence to ART in PLHIV. With its high sensitivity and adequate specificity, it proves to be an effective tool for clinical practice. Its implementation can significantly enhance medication

therapy management for PLHIV, contributing to better virological outcomes and overall health management.

We recommend further refining of the MCQ and conducting factor analysis could provide insights into the underlying structure of the instrument. This analysis may help identify any redundant items and enhance the overall validity and reliability of the questionnaire.

CONFLICT OF INTEREST

The authors declare that no conflict of interest may arise from the research publication.

ETHICS APPROVAL

Registration for this study was completed through the National Medical Research Register (NMRR)and ethically approved by the Malaysia Ministry of Health Research Ethical Committee (MREC) with the NMRR identification number NMRR-12-335-11995. Signed, written informed consent was acquired from all patients before the study.

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