Medication Adherence of Persons with Type 2 Diabetes in Malaysia: A Scoping Review and Meta-Analysis

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Abstract

Objective. This is a scoping review of Malaysian scientific studies on medication adherence among persons with type 2 diabetes mellitus (T2DM).

Methodology. We conducted a bibliographic search of PubMed, Scopus and Google Scholar using the following keywords: “medication adherence,” “drug compliance,” “DMTAC” and “Malaysia.” The search covered all publications up to 31 December 2021. Eligible articles were original studies conducted in Malaysia that measured or quantified medication adherence among persons with T2DM.

Results. We identified 64 eligible studies published between 2008 to 2021. Most studies included patients with T2DM in ambulatory facilities. Five studies were qualitative research. The quantitative research publications included clinical trials, and cross-sectional, validation, retrospective and prospective cohort studies. Thirty-eight studies used medication adherence scales. The Morisky Medication Adherence Scale (MMAS-8, used in 20 studies) and Malaysian Medication Adherence Scale (MALMAS, used in 6 studies) were the most commonly used tools. There were 6 validation studies with 4 medication adherence scales. A meta-analysis of 10 studies using MMAS-8 or MALMAS revealed that the pooled prevalence of low medication adherence is 34.2% (95% CI: 27.4 to 41.2, random effects model). Eighteen publications evaluated various aspects of the Diabetes Medication Therapy Adherence Clinics (DMTAC).

Conclusion. This scoping review documented extensive research on medication adherence among persons with diabetes in Malaysia. The quantitative meta-analysis showed a pooled low medication adherence rate.

Key words: diabetes mellitus, medication adherence, Malaysia, scoping review

INTRODUCTION

Diabetes mellitus is a major health issue worldwide with an increasing incidence over the past few decades.1 In Malaysia, the prevalence of diabetes escalated alarmingly from 11.2% in 2011, to 13.4% in 2015, and to 18.3% in 2019, affecting 3.9 million people aged 18 and above.2 This increase is associated with the parallel rise in the prevalence of overweight and obese individuals.3 As one of the major non-communicable diseases, type 2 diabetes mellitus poses a significant challenge to the Malaysian healthcare system, estimated to incur a total annual cost of MYR 2,484 million (USD 600 million) annually.4

Malaysia’s healthcare system is composed of both public and private sectors. In the public health clinics where most patients with diabetes are treated, patient care is undertaken by a medical officer, who may refer selected patients to a Diabetes Medication Therapy Adherence Clinic (DMTAC). In Malaysia, DMTAC was started in 2004 by the Pharmaceutical Services as an ambulatory care service managed by the pharmacist for patients with diabetes to improve their medication adherence and glycemic control.5 A recent systematic review of DMTAC studies from Southeast Asia conducted by Dwiputri et al., concluded that pharmacists can contribute to improve diabetes management in a variety of settings.6 Of the 16 articles included in the above review, half (8 studies) came from Malaysia.6

Good glycemic control of diabetes is essential to prevent long-term microvascular and macrovascular complications. One component of self-management is medication adherence to pharmacologic regimens. Optimal medication adherence is associated with a lower risk of diabetes complications, lower health care costs and lower mortality rates.7 While there are many studies on medication adherence in Malaysia, currently, there is no...
scoping review that provides a global picture of medication adherence among persons with diabetes and efforts to deal with it in the local context. The data generated from this scoping review can provide pointers for the planning of further research on diabetes medication adherence and DMTAC in Malaysia.

**METHODOLOGY**

This scoping review aims to describe Malaysian scientific studies on the topic of medication adherence among patients with diabetes. We searched PubMed and Scopus using a combination of the search terms such as “diabetes mellitus,” “medication adherence,” “drug compliance,” “DMTAC and “Malaysia,” covering publications up to 31 December 2021. This was supplemented by a Google Scholar search using the same text words. The citations were processed using Endnote 20 citation manager.8 Keywords of all citations were coded for study designs, study settings (primary or tertiary care) and any medication adherence data and its associated factors.

The inclusion criteria for eligible studies were:
1. Original research conducted in Malaysia;
2. Studies that measured or discussed medication adherence and associated factors;
3. Study participants must be patients diagnosed with both type 1 and type 2 diabetes mellitus.

We excluded the following types of publications: books, monographs, reports, case reports, conference abstracts, editorials, letters, comments, reviews (narrative or systematic), study protocols and theses or dissertations.

The full text of eligible studies were retrieved. Relevant data in the included studies were extracted by a pair of investigators. Meta-analysis of prevalence data on low medication adherence was performed using MedCalc® Statistical Software. Fixed effects model was selected if the study heterogeneity (I²) were less than 50%; otherwise, random effects model was used.9

This review was prepared following the PRISMA guideline.10 Quality assessment of the published studies was performed using a checklist for prevalence studies published by Joanna Briggs Institute (JBI).11

**RESULTS**

**Search results**

Of the 147 items retrieved from the bibliographic databases and internet search, 68 journal articles published between 2008 to 2021 were deemed eligible for qualitative analysis. However, only 64 articles were used for qualitative analysis as four articles found to be published in “predatory journals” were excluded. Ten publications that provide prevalence data on medication adherence were selected for quantitative analysis (Figure 1).12-21

**Figure 1.** PRISMA flow diagram.

- conference abstract=12; non-journal=36 (monographs, reports, theses); non-Malaysian publication=14; case report=2; comment/letter=2; correction=1; review (narrative/systematic)=7; study protocol=3; retracted publication=1 [number added is more than 63 because some excluded publications are in several categories]
- no measurement or exploration of medication adherence=4; Not focused on general diabetes care in adults=12 (asthma, diet, hyperlipidemia, hypertension, telemonitoring, tuberculosis, validation); type 1 diabetes in children=1

**Qualitative assessment**

**A. Study participants**

Most study participants had T2DM (59 studies). In 5 studies, both type 1 diabetes mellitus (T1DM) and T2DM patients were recruited.22-26 However, 5 studies did not mention if the study participants had T1DM or T2DM.27-31

**B. Study site**

In 53 studies, the study site included an ambulatory clinic; in 32 of them, a primary care clinic was used. In 41 studies, the study took place in a hospital setting (wards, outpatient clinics or pharmacies). In one study, the study site was unclear.25

**C. Study design**

Out of the 64 included studies, 59 were quantitative research, while 5 were qualitative research.26,32-35 Among the quantitative studies, we found 16 clinical trials, 6 validation studies, 7 retrospective studies and 2 prospective cohort studies, while the rest were cross-sectional studies.

**D. Measurement tool for medication adherence**

In 38 studies, a named medication adherence scale was used. The most commonly used was the Morisky Medication Adherence Scale (MMAS-8), seen in 20
studies. Six studies used the Malaysian Medication Adherence Scale (MALMAS). The other scales and the number of respective studies that utilized them were the Adherence to Refills and Medications Scale (ARMS, 2 studies), the Medication Compliance Questionnaire (MCQ, 7 studies), the Drug Attitude Inventory (DAI-10, 1 study), the Malaysia Medication Adherence Assessment Tool (MyMAAT, 1 study), the PATIENT-Medication Adherence Instrument (P-MAI, 1 study), the Self-Efficacy for Appropriate Medication Use Scale (SEAMS, 2 studies), and the Malay Elderly Diabetes Self-Care Questionnaire (MEDSCaQ, 1 study). Medication adherence was measured using a self-developed questionnaire in 6 studies. Three studies used pill count and the medication dose, frequency, indication and time score (DFIT). Otherwise, it was measured using a self-reporting questionnaire.

### E. Study objectives

The objectives of the included studies can be categorized as:
1. Validation of medication adherence scales; and
2. Prevalence and factors associated with medication adherence; and
3. Intervention to promote self-care and medication adherence.

### F. Validation studies

We identified 6 publications reporting psychometric data using four rating scales on medication adherence in Malaysia: MMAS-8, 2 studies; MALMAS, 2 studies; MyMAAT, 1 study; and P-MAI, 1 study (Table 1). We noted that both MMAS-8 and MALMAS had more extensive reliability and validity data, but as noted by Hatah et al., the use of these two copyrighted scales requires substantial payment.

### G. Prevalence and factors associated with low medication adherence

#### 1. Prevalence of low medication adherence

Many Malaysian studies measured medication adherence. We found 15 cross-sectional studies that used either MMAS-8 or MALMAS. In light of the comparability of prevalence data, a meta-analysis on low medication adherence was performed. After excluding studies where medication adherence data was not extractable or where the same dataset was used, we narrowed the list down to 10 studies. The MMAS-8 was more commonly used in measuring medication adherence (8 studies), followed by MALMAS (4 studies); 2 publications reported prevalence data using both scales. The reported medication adherence rates varied from 11.7% to 44.8% (Table 2). All the included studies received a moderate to high quality rating in the JBI critical appraisal tool for prevalence study.

A meta-analysis of 10 studies (N=2836) using MMAS-8 and MALMAS was performed. We felt that this synthesis was appropriate since MALMAS was developed based on MMAS-8 using the same definition for degrees of medication adherence. There was high heterogeneity. The random effects model showed the summative prevalence

### Table 1. Malaysian validation studies on medication adherence scale in type 2 diabetes

| Study          | Scale                  | Setting                             | Participants          | Method                                                                 | Data                                                                 |
|----------------|------------------------|-------------------------------------|-----------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|
| Al-Abboud 2016 | MMAS-8 (Malay version) | Hospital clinic                     | 62 T1DM adults, mean age 47 years | MMAS-8 (and 2 other scales: PDSMS, MUSE) translated to Malay. Reliability and correlation assessed using Partial Credit Rasch Model | Reliability and correlation of 24-item composite scale is produced. The person reliability (r=0.76) and item reliability (r=0.93) were good to excellent |
| Al-Qazaz 2010  | MMAS-8 (Malay version) | Hospital clinic                     | 223 T2DM adults, mean age 61 years | MMAS-8 translated to Malay. Test re-test reliability done for 39 subjects. Correlation with MAS-4' and HbA1c. | Cronbach's alpha: 0.675 MMAS-8 vs MAS-4' correlation: r=0.792 MMAS-8 categories vs HbA1c categories: significant relationship |
| Chung 2015    | MALMAS (English version) | Hospital clinic                     | 136 T2DM adults, mean age 58 years | Test re-test reliability done 4 weeks later. Correlation with MMAS-8 Scale and HbA1c. | Cronbach's alpha: 0.565 MALMAS vs MMAS-8 correlation: rho=0.715 MALMAS adherent group had lower HbA1c |
| Goh 2020      | P-MAI (English version) | Primary care clinic                 | 120 T2DM adults | Developed using the nominal group technique.                           | Cronbach's alpha: 0.722                                                                 |
| Hatah 2020    | MyMAAT (Malay version) | Hospital clinic                     | 495 T2DM adults | Newly developed 12-item Malay questionnaire. Correlation with SEAMS Scale and HbA1c. | Cronbach's alpha: 0.910                                                                 |
| Lai 2020      | MALMAS (Malay version) | Hospital clinic                     | 100 T2DM adults | MALMAS translated to Malay. Test re-test reliability done 4 weeks later. Correlation with MMAS-8 Scale and HbA1c. | Cronbach's alpha: 0.654; Test-retest no significant difference for any item; correlation between MMAS-8; Spearman's rho=0.797; HbA1c higher in those with better adherence |

MMAS-8: 8-item Morisky Medication Adherence Scale
T1DM: type 1 diabetes mellitus
T2DM: type 2 diabetes mellitus
PDSMS: Perceived Diabetes Self-Management Scale
MUSE: Medication Understanding and Use Self-Efficacy Scale
MAS-4: 4-item Morisky Adherence Scale
HbA1c: glycosylated hemoglobin
MALMAS: Malaysian Medication Adherence Scale
P-MAI: PATIENT-Medication Adherence Instrument
MyMAAT: Malaysia Medication Adherence Assessment Tool
SEAMS: Self-Efficacy for Appropriate Medication Use Scale
Table 2. Malaysian studies providing medication adherence data using rating scales in type 2 diabetes

| Study                  | Scale                  | Setting                      | Participants                  | JBI checklist score | Medication adherence: high, moderate, low (%) | Risk factors for low adherence |
|------------------------|------------------------|------------------------------|-------------------------------|---------------------|-----------------------------------------------|--------------------------------|
| Abu Bakar 2016         | MMAS-8                 | Hospital clinic              | 165 T2DM adults, mean age not available | 6                   | 26.1, 29.1, 44.8                           | Younger age, male gender, lower education |
| Al-Amedy 2016          | MMAS-8                 | Hospital clinic              | 223 T2DM adults, mean age 57.9 years | 7                   | 1.3, 87.0, 11.7                            | Not associated with socio-demographic factors, knowledge |
| Al-Qazaz 2010          | MMAS-8                 | Hospital clinic              | 223 T2DM adults, mean age 61 years | 6                   | 17.1, 44.5, 38.2                           | Lower education, larger number of medications |
| Balasubramaniam 2019   | MMAS-8                 | Hospital clinic              | 384 T2DM adults, mean age 58 years | 8                   | 23.7, 36.2, 39.6                           | NA*
| Chew 2015              | MMAS-8                 | Primary care clinic          | 668 T2DM adults, mean age not available | 8                   | 0.1, 57.1, 42.8                            | Younger age, Malay ethnicity, higher income, higher education, less exercise, lower HRQoL, higher diabetes distress depressive symptoms |
| Chung 2015             | MMAS-8 and MALMASd    | Hospital clinic              | 136 T2DM adults, mean age 58 years | 7                   | 30.1, 43.4, 26.5                           | NA* |
| Dhillon 2019           | MALMASd                | Primary care clinic          | 150 T2DM adults, mean age 59.4 years | 7                   | 54.7, 16.7, 28.7                           | NA* |
| Jannoo 2019            | MMAS-8                 | Hospital clinic and primary care clinic | 497 T2DM adults, mean age not available | 8                   | 17.7, 37.6, 44.7                           | Malay ethnicity, longer duration of diabetes, higher BMI* |
| Lai 2020               | MMAS-8 and MALMASd    | Hospital clinic              | 100 T2DM adults, mean age 64 years | 7                   | 43.0, 33.0, 24.0                           | NA* |
| Nini 2019              | MALMASd                | Primary care clinic          | 338 T2DM adults, mean age not available | 8                   | 20.4, 37.0, 42.6                           | NA* |

* JBI checklist score, Joanna Briggs Institute checklist score using critical appraisal tool for prevalence study
* MMAS-8, 8-item Morisky Medication Adherence Scale
* T2DM, type 2 diabetes mellitus
* MALMAS, Malaysian Medication Adherence Scale
* NA, not available
* HRQoL, health-related quality of life
* BMI, body mass index

Figure 2. Meta-analysis of studies on medication adherence.

of low medication adherence to be 34.2% (95% CI: 27.4 to 41.2) (Figure 2). The prevalence of low medication adherence in primary care and hospital-based studies were 37.5% (95% CI: 31.3 to 43.9) and 32.3% (22.8 to 42.6), respectively.

2. Risk factors for low medication adherence

Data on risk factors for low medication adherence was available in five studies (Table 2). The factors associated with medication adherence were somewhat conflicting. These studies were not originally designed to investigate risk factors for low medication adherence and the type and definition of risk factors assessed were not standardized.

H. Diabetes medication therapy adherence clinic

Eighteen publications on DMTAC were retrieved (Table 3).12,24,26,29,31,37,44,45,65-74 The study designs included 1 qualitative research,29 3 cross-sectional studies,12,28,31 6 retrospective studies14,44,45,65,71,73 and 8 randomized controlled trials (RCTs).37,66-69,71,72,74 The retrospective studies reported an HbA1c reduction between 1.0 to 1.7% (end of study versus baseline) after 4 to 8 DMTAC consultations done on top of usual care. All RCTs, except that of Butt et al.,37 showed reduction of HbA1c at the end of the study. Dropouts from the RCTs were substantial, varying between 9.6 to 26.5%. Iqbal et al., and Khan et al., published 5 RCTs based on a single project and showed a statistically significant reduction of HbA1c and apparent reduction of symptoms attributable to diabetes complications within
Table 3. Malaysian studies providing data on diabetes medication adherence therapy clinic (DMTAC) in type 2 diabetes

| Study       | Study design | Participants | Methods                                                                 | Findings                                                                 |
|-------------|--------------|--------------|--------------------------------------------------------------------------|--------------------------------------------------------------------------|
| Abu Bakar 2016(1) | Cross-sectional study | Hospital clinic 165 T2DM(8) adults, mean age 57 | Patients recruited over three months. They had attended at least one visit in the DMTAC. | 87% of patients reported satisfied with DMTAC service. HbA1c change not reported. |
| Alison 2020(2) | Randomized controlled trial | Primary care clinic 100 T2DM(4) adults, mean age 52 years | Patients randomized to receive treatment at DMTAC in addition to usual care vs usual care alone. Intervention group received at least four DMTAC consultation. | HbA1c reduction at one year: intervention group 1.58%, control group 0.48% (p<0.05). Drop-out 14%. |
| Azmi 2020(3) | Cross-sectional study | Hospital and primary care clinics 275 T2DM(2) adults | Controls were patients who were not managed in DMTAC(n=144). Intervention group had attended at least four visits in the DMTAC(n=131). Medication adherence was assessed using Medication Compliance Questionnaire. | Thirty (10.9%) patients were non-adherent in the control group while 15 (5.5%) patients were non-adherent in the intervention group. |
| Butt 2016(4) | Randomized controlled trial | Hospital clinic 73 T2DM(2) adults | Patients randomized to receive treatment at DMTAC in addition to usual care vs usual care alone. Intervention group received three DMTAC consultation. | No statistically significant difference in HbA1c at six months between intervention and control group. Drop-out 9.6%. |
| Iqbal 2021(5) | Randomized controlled trial | Hospital clinic 400 T2DM(3) adults | Patients randomized to receive treatment at DMTAC vs usual care alone. After baseline evaluation, intervention group received two DMTAC consultation. | Baseline HbA1c 11.15% (control) and 11.69% (intervention); end of study HbA1c 9.72% (control) and 8.87% (intervention). Drop-out 26.5%. |
| Karunagaran 2018(6) | Retrospective study | Hospital clinic 213 T2DM(3) adults | Retrospective review of medical record. Intervention group received up to seven DMTAC consultation. | Reduction of HbA1c was achieved, results reported graphically (mean change HbA1c cannot be extracted). Drop-out not reported. |
| Lau 2018(7) | Retrospective cohort study | Hospital clinic 58 T2DM(2) adults | Comparison of one-year outcome in patients followed up by pharmacist vs usual medical care | Pharmacist group: Baseline HbA1c 11.16%, end of study HbA1c 9.57%. Usual medical care: Baseline HbA1c 9.26%, end of study HbA1c 9.09%. |
| You 2015(8) | Retrospective study | Primary care clinic 56 T2DM(2) adults | Retrospective review of medical record. Intervention group received four DMTAC consultation. | Reduction of HbA1c(1) achieved (mean change 1.9%). |
| Lim 2010(9) | Retrospective study | Hospital clinic 76 T2DM(2) adults | Retrospective review of medical record. Intervention group received eight DMTAC consultation. | Reduction of HbA1c(1) achieved (mean change 1.7%). |
| Lim 2016(10) | Randomized controlled trial | Hospital clinic 120 T2DM(2) adults | Patients randomized to receive treatment at DMTAC in addition to usual care vs usual care alone. Intervention group received eight DMTAC consultation. | HbA1c reduction at one year: intervention group 0.9%, control group 0.0% (p<0.05). Drop-out 24%. |
| Sim 2021(11) | Cross-sectional study | Hospital clinic 37 T2DM(2) adults | Patient satisfaction of 148 patients (37 had diabetes) followed up in medication therapy adherence clinic. | No HbA1c outcome data. Patient satisfaction data not extractable for diabetes patients. |
| Tai 2016(12) | Retrospective study | Primary care clinic 100 T2DM(2) adults | Retrospective review of medical record. Intervention group received four or more DMTAC consultation. | Reduction of HbA1c(1) achieved (mean change 1.9%). |
| Tey 2020(13) | Retrospective study | Primary care clinic 80 T2DM(2) adults | Retrospective review of medical record. Intervention group received four or more DMTAC consultation. | Reduction of HbA1c(1) achieved (mean change 1.0%). |

a T2DM, type 2 diabetes mellitus
b DMTAC, Diabetes Medication Therapy Adherence Clinics
c HbA1c, glycylated hemoglobin
d There are five randomized controlled trial published by this group, all apparently coming from one single project [same ethics approval number: KKM/NIHSEC/P18-1307(13)]. See references 71-73,75,76.

Qualitative studies We identified 5 qualitative studies; 23,33-38 2 were based on the same population of 21 physically disabled T2DM patients.34 The study of Al-Qazaz et al.,32 involved 12 T2DM adults who were mostly university staff, while that of Saidi et al.,39 included 18 T2DM patients. Selvadurai et al., interviewed 10 pharmacists to explore pharmacist-patient active engagement during DMTAC consultation.39 All the qualitative studies cited employed semi-structured interviews and provided insights into patients’ views about their health conditions, especially regarding self-care and medication adherence.

DISCUSSION Medication adherence is a critical determinant of outcomes in persons with diabetes. To our knowledge, this is the first scoping review that maps the published studies on medication adherence among persons with diabetes in Malaysia. We identified 64 Malaysian studies published in the past 13 years that examined medication adherence among persons with diabetes in Malaysia; they all included T2DM patients and a minority also included T1DM patients. As expected, the included studies covered a broad scope, with the nature of the studies ranging from estimation of prevalence of low medication adherence and associated factors, validation of measurement tools for medication adherence, qualitative research and various interventional studies.

We found 6 studies assessing the psychometric properties of 4 rating scales on medication adherence in Malaysian adult patients with diabetes. While MMAS-8 and MALMAS have more comprehensive reliability and validity data, the need for payment for their application may restrict their usage among researchers without substantial funding support. In response to such limitations, the MyMAAT was specifically developed by Hatah et al., to provide a more accessible alternative. The MMAS-8 reportedly has
Medication adherence rate varied depending on how adherence was defined (since they used different rating scales), and the type of population studied. It was opportune in our scoping review that we managed to identify a subset of Malaysian studies suitable for systematic review. Our meta-analysis of 10 studies using either MMAS-8 or MALMAS revealed a pooled low medication adherence rate of 34.4%. This finding confirms that at least a third of Malaysian patients with diabetes took less than the prescribed amount of medication, an observation that is similar to the pooled data from other low- and middle-income countries (43.4%, 95% CI: 17.5-69.4). The high prevalence of low medication adherence among Malaysian patients with diabetes emphasizes the need for health practitioners dealing with diabetes care to recognize and act on this issue. We anticipate that this substantial problem of poor adherence has substantial clinical and financial implications, as shown in the systematic review by Kennedy et al. However, our scoping review identified fewer studies investigating the factors associated with low medication adherence. The risk factors identified appeared to be heterogenous, possibly due to methodological differences such as lack of uniformity in the questionnaire investigating this issue. The variable quality of evidence investigating this aspect is also noted by other systematic reviews. Considering the importance of medication adherence, further exploration of the reasons for this in the local context is essential to crafting subsequent tailored interventions.

Our scoping review identified 18 studies involving DMTAC, with many of them intended to assess the impact of DMTAC on glycemic control. These DMTACs are pharmacist-run diabetes service units focusing on patients with poor glycemic control. The interventions provided beyond drug management include dietary and lifestyle modification. Although most were observational studies, it is noteworthy that 8 were randomized controlled trials. However, it is possible that 5 of these trials were duplicated publications from one single project.

Observational studies also potentially have the bias of including patients who were compliant with DMTAC service, especially those using cross-sectional design or are retrospective in nature. In fact, we failed to find any prospective cohort studies or randomized controlled studies that extended the study period beyond 1 year, suggesting that the long-term impact of DMTAC in Malaysia is still an unexplored area. The Malaysian DMTAC trials showed an HbA1c reduction of approximately 1% after multiple visits in one year, but the drop-out rates were not negligible. The impact of DMTAC in Malaysia is consistent with the findings demonstrated in the systematic review of international literature.

This scoping review relied only on published peer reviewed scientific studies originating from Malaysia. The findings may change when more publications on this topic are published.

CONCLUSION

This scoping review documented extensive research on medication adherence among persons with diabetes in Malaysia. The information generated from this study can help design future investigations on this topic.

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All authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

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