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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

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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 (I^2) 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]
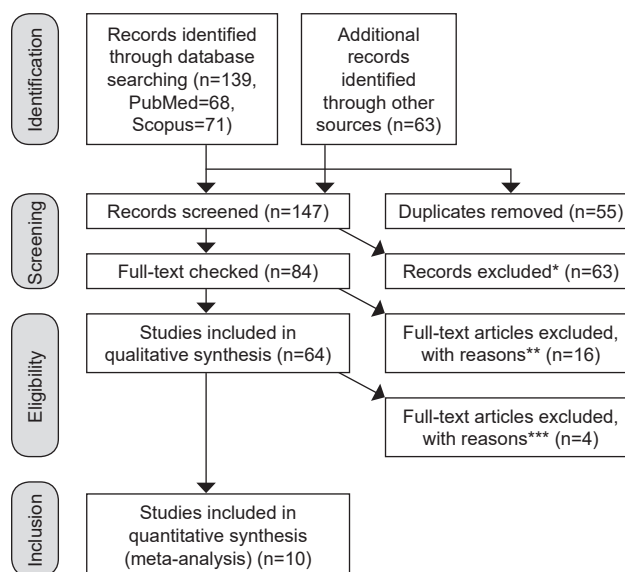

Figure 1. PRISMA flow diagram.

*   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

***   published in predatory journals

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.[27]

C. Study design

Out of the 64 included studies, 59 were quantitative research, while 5 were qualitative research.[29,32-35] 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.[12-17,19,20,23,24,36-45] Six studies used the Malaysian Medication Adherence Scale (MALMAS).[17,18,20,21,42,46,47] The other scales and the number of respective studies that utilized them were the Adherence to Refills and Medications Scale (ARMS, 2 studies),[48,49] the Medication Compliance Questionnaire (MCQ, 7 studies),[28,50-55] the Drug Attitude Inventory (DAI-10, 1 study),[56] the Malaysia Medication Adherence Assessment Tool (MyMAAT, 1 study),[57] the PATIENT-Medication Adherence Instrument (P-MAI, 1 study),[58] the Self-Efficacy for Appropriate Medication Use Scale (SEAMS, 2 studies),[57,59] and the Malay Elderly Diabetes Self-Care Questionnaire (MEDSCaQ, 1 study).[60] Medication adherence was measured using a self-developed questionnaire in 6 studies.[22,25,26,61-63] Three studies used pill count[30,64,65] and the medication dose, frequency, indication and time score (DFIT).[66]

E. Study objectives

The objectives of the included studies can be categorized as:
1. Validation of medication adherence scales;
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;[23,36] MALMAS, 2 studies;[17,20] MyMAAT, 1 study;[57] and P-MAI, 1 study[58] (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.[57]

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.[12–21] 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[12-21] (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[23]	MMAS-8[a] (Malay version)	Hospital clinic	62 T1DM[b]/ T2DM[c] adults, mean age 47 years	MMAS-8[a] (and 2 other scales: PDSMS[d], MUSE[e]) 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 (α=0.76) and item reliability (α=0.93) were good to excellent
Al-Qazaz 2010[14]	MMAS-8[a] (Malay version)	Hospital clinic	223 T2DM[c] adults, mean age 61 years	MMAS-8[a] translated to Malay. Test re-test reliability done for 39 subjects. Correlation with MAS-4[f] and HbA1c[g].	Cronbach's alpha: 0.675 MMAS-8[a] vs MAS-4[f] correlation: r=0.792 MMAS-8[a] categories vs HbA1c[g] categories: significant relationship
Chung 2015[17]	MALMAS[h] (English version)	Hospital clinic	136 T2DM[c] adults, mean age 58 years	Test re-test reliability done 4 weeks later. Correlation with MMAS-8[a] Scale and HbA1c[g].	Cronbach's alpha: 0.565 MALMAS[h] vs MMAS-8[a] correlation: rho=0.715 MALMAS[h] adherent group had lower HbA1c[g]
Goh 2020[58]	P-MAI[i] (English version)	Primary care clinic	120 T2DM[c] adults	Developed using the nominal group technique.	Cronbach's alpha: 0.722
Hatah 2020[57]	MyMAAT[j] (Malay version)	Both hospital clinic and primary care clinic	495 T2DM[c] adults	Newly developed 12-item Malay questionnaire. Correlation with SEAMS[k] Scale and HbA1c[g].	Cronbach's alpha: 0.910
Lai 2020[20]	MALMAS[h] (Malay version)	Hospital clinic	100 T2DM[c] adults	MALMAS[h] translated to Malay. Test re-test reliability done 4 weeks later. Correlation with MMAS-8[a] Scale and HbA1c[g].	Cronbach's alpha: 0.654; Test-retest: no significant difference for any Item; correlation between MMAS-8[a]: Spearman's rho=0.797; HbA1c[g] higher in those with better adherence

[a] MMAS-8: 8-item Morisky Medication Adherence Scale
[b] T1DM, type 1 diabetes mellitus
[c] T2DM, type 2 diabetes mellitus
[d] PDSMS, Perceived Diabetes Self-Management Scale
[e] MUSE, Medication Understanding and Use Self-Efficacy Scale
[f] MAS-4, 4-item Morisky Adherence Scale
[g] HbA1c, glycosylated hemoglobin
[h] MALMAS, Malaysian Medication Adherence Scale
[i] P-MAI, PATIENT-Medication Adherence Instrument
[j] MyMAAT, Malaysia Medication Adherence Assessment Tool
[k] 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[a]	Medication adherence: high, moderate, low (%)	Risk factors for low adherence
Abu Bakar 2016[12]	MMAS-8[b]	Hospital clinic	165 T2DM[b] adults, mean age not available	6	26.1, 29.1, 44.8	Younger age, male gender, lower education
Al-Amedy 2016[13]	MMAS-8[b]	Hospital clinic	223 T2DM[b] adults, mean age 57.9 years	7	1.3, 87.0, 11.7	Not associated with socio-demographic factors, knowledge
Al-Qazaz 2010[14]	MMAS-8[b]	Hospital clinic	223 T2DM[b] adults, mean age 61 years	6	17.1, 44.5, 38.2	Lower education, larger number of medications
Balasubramaniam 2019[15]	MMAS-8[b]	Hospital clinic	384 T2DM[b] adults, mean age 58 years	8	23.7, 36.2, 39.6	NA[e]
Chew 2015[16]	MMAS-8[b]	Primary care clinic	668 T2DM[b] adults, mean age not available	8	0.1, 57.1, 42.8	Younger age, Malay ethnicity, higher income, higher education, less exercise, lower HRQoL[f], higher diabetes distress depressive symptoms
Chung 2015[17]	MMAS-8[b] and MALMAS[d]	Hospital clinic	136 T2DM[b] adults, mean age 58 years	7	30.1, 43.4, 26.5	NA[e]
Dhillon 2019[18]	MALMAS[d]	Primary care clinic	150 T2DM[b] adults, mean age 59.4 years	7	54.7, 16.7, 28.7	NA[e]
Jannoo 2019[19]	MMAS-8[b]	Hospital clinic and primary care clinic	497 T2DM[b] adults, mean age not available	8	17.7, 37.6, 44.7	Malay ethnicity, longer duration of diabetes, higher BMI[g]
Lai 2020[20]	MMAS-8[b] and MALMAS[d]	Hospital clinic	100 T2DM[b] adults, mean age 64 years	7	43.0, 33.0, 24.0	NA[e]
Nini 2019[21]	MALMAS[d]	Primary care clinic	338 T2DM[b] adults, mean age not available	8	20.4, 37.0, 42.6	NA[e]

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

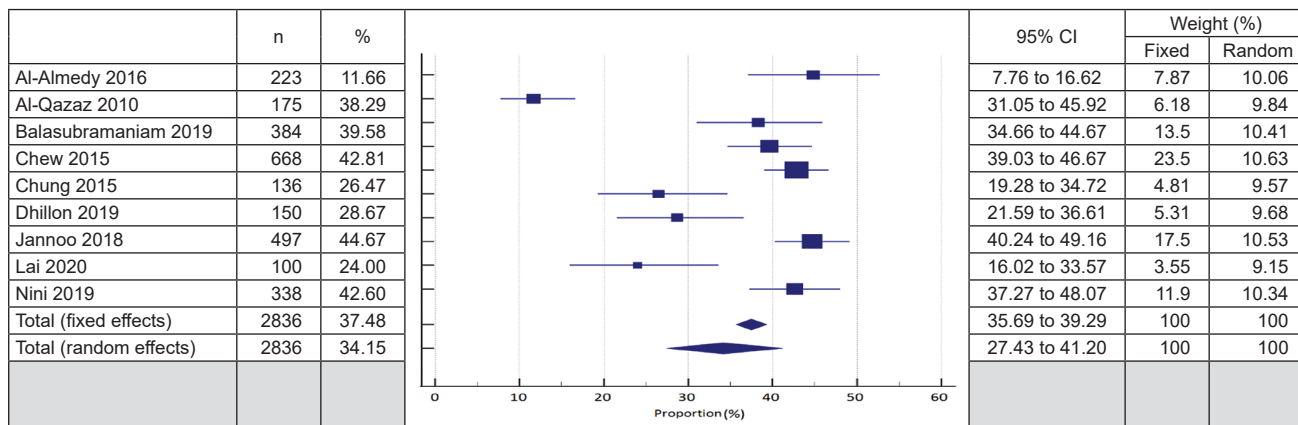|	n	%		95% CI	Weight (%) Fixed	Weight (%) Random
Al-Almedy 2016	223	11.66		7.76 to 16.62	7.87	10.06
Al-Qazaz 2010	175	38.29		31.05 to 45.92	6.18	9.84
Balasubramaniam 2019	384	39.58		34.66 to 44.67	13.5	10.41
Chew 2015	668	42.81		39.03 to 46.67	23.5	10.63
Chung 2015	136	26.47		19.28 to 34.72	4.81	9.57
Dhillon 2019	150	28.67		21.59 to 36.61	5.31	9.68
Jannoo 2018	497	44.67		40.24 to 49.16	17.5	10.53
Lai 2020	100	24.00		16.02 to 33.57	3.55	9.15
Nini 2019	338	42.60		37.27 to 48.07	11.9	10.34
Total (fixed effects)	2836	37.48		35.69 to 39.29	100	100
Total (random effects)	2836	34.15		27.43 to 41.20	100	100

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).[12,24,28,29,31,37,44,45,65-74] The study designs included 1 qualitative research,[29] 3 cross-sectional studies,[12,28,31] 6 retrospective studies[24,44,45,65,70,73] 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[12]	Cross-sectional study	Hospital clinic 165 T2DM[a] adults, mean age ?	Patients recruited over three months. They had attended at least one visit in the DMTAC[b].	87% of patients reported satisfied with DMTAC[b] service. HbA1c[c] change not reported.
Alison 2020[66]	Randomized controlled trial	Primary care clinic 100 T2DM[a] adults, mean age 52 years	Patients randomized to receive treatment at DMTAC[b] in addition to usual care vs usual care alone. Intervention group received at least four DMTAC[b] consultation.	HbA1c[c] reduction at one year: intervention group 1.58%, control group 0.48% (p<0.05). Drop-out 14%.
Azmi 2020[53]	Cross-sectional study	Hospital and primary care clinics 275 T2DM[a] adults	Controls were patients who were not managed in DMTAC[b] (n=144). Intervention group had attended at least four visits in the DMTAC[b] (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[37]	Randomized controlled trial	Hospital clinic 73 T2DM[a] adults	Patients randomized to receive treatment at DMTAC[b] in addition to usual care vs usual care alone. Intervention group received three DMTAC[b] consultation.	No statistically significant difference in HbA1c[c] at six months between intervention and control group. Drop-out 9.6%.
Iqbal 2021*	Randomized controlled trial	Hospital clinic 400 T2DM[a] adults	Patients randomized to receive treatment at DMTAC[b] vs usual care alone. After baseline evaluation, intervention group received two DMTAC[b] consultation.	Baseline HbA1c[c] 11.15 % (control) and 11.69% (intervention); end of study HbA1c 9.72% (control) and 8.87% (intervention). Drop-out 26.5%.
Karunagaran 2018[70]	Retrospective study	Hospital clinic 213 T2DM[a] adults	Retrospective review of medical record. Intervention group received up to seven DMTAC[b] consultation.	Reduction of HbA1c[c] was achieved, results reported graphically (mean change in HbA1c[c] cannot be extracted). Drop-out not reported.
Lau 2018[73]	Retrospective cohort study	Hospital clinic 58 T2DM[a] adults	Comparison of one-year outcome in patients followed up by pharmacist vs usual medical care	Pharmacist group: Baseline HbA1c[c] 11.16%, end of study HbA1c[c] 9.57% Usual medical care: Baseline HbA1c[c] 9.26%, end of study HbA1c[c] 9.09%.
You 2015[44]	Retrospective study	Primary care clinic 56 T2DM[a] adults	Retrospective review of medical record. Intervention group received four DMTAC[b] consultation.	Reduction of HbA1c[c] achieved (mean change 1.0%).
Lim 2010[24]	Retrospective study	Hospital clinic 76 T2DM[a] adults	Retrospective review of medical record. Intervention group received eight DMTAC[b] consultation	Reduction of HbA1c[c] achieved (mean change 1.7%).
Lim 2016[74]	Randomized controlled trial	Hospital clinic 120 T2DM[a] adults	Patients randomized to receive treatment at DMTAC[b] in addition to usual care vs usual care alone. Intervention group received eight DMTAC[b] consultation.	HbA1c[c] reduction at one year: intervention group 0.9%, control group 0.08% (p<0.05). Drop-out 24%.
Sim 2021[31]	Cross-sectional study	Hospital clinic 37 T2DM[a] adults	Patient satisfaction of 148 patients (37 had diabetes) followed up in medication therapy adherence clinic.	No HbA1c[c] outcome data. Patient satisfaction data not extractable for diabetes patients.
Tai 2016[45]	Retrospective study	Primary care clinic 100 T2DM[a] adults	Retrospective review of medical record. Intervention group received four or more DMTAC[b] consultation.	Reduction of HbA1c[c] achieved (mean change 1.0%).
Tey 2020[65]	Retrospective study	Primary care clinic 80 T2DM[a] adults	Retrospective review of medical record. Intervention group received four or more DMTAC[b] consultation.	Reduction of HbA1c[c] achieved (mean change 1.0%).

[a] T2DM, type 2 diabetes mellitus
[b] DMTAC, Diabetes Medication Therapy Adherence Clinics
[c] HbA1c, glycosylated hemoglobin
* 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.

one year, which is a surprising finding.[67-69,71,72] Only 6 out of 18 DMTAC studies measured medication adherence; 5 of them used MMAS-8,[12,24,28,37,44,45] and 1 used the MCQ.[28]

Qualitative studies

We identified 5 qualitative studies;[29,32-35] 2 were based on the same population of 21 physically disabled T2DM patients.[33,34] The study of Al-Qazaz et al.,[32] involved 12 T2DM adults who were mostly university staff, while that of Saidi et al.,[35] included 18 T2DM patients. Selvadurai et al., interviewed 10 pharmacists to explore pharmacist-patient active engagement during DMTAC consultation.[29] 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.[57] The MMAS-8 reportedly has

33 language versions. Since it is widely used in various countries, it has the unique advantage of allowing cross-national comparison.[77-79]

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).[80] 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.[79] 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.[7,80] 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 glycaemic 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.[37,66-69,71,72,74] However, it is possible that 5 of these trials were duplicated publications from one single project.[67-69,71,72]

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.[81]

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.

References
1. Zheng Y, Ley SH, Hu FB. Global aetiology and epidemiology of type 2 diabetes mellitus and its complications. Nat Rev Endocrinol. 2018;14(2):88-98. PMID: 29219149. https://doi.org/10.1038/nrendo.2017.151.
2. National Health and Morbidity Survey 2019. Shah Alam, Selangor: Institute for Public Health, National Institutes of Health, Ministry of Health, Malaysia; 2020. https://iptk.moh.gov.my/images/technical_report/2020/4_Infographic_Booklet_NHMS_2019_-_English.pdf.
3. Jan Mohamed HJ, Yap RW, Loy SL, Norris SA, Biesma R, Aagaard-Hansen J. Prevalence and determinants of overweight, obesity, and type 2 diabetes mellitus in adults in Malaysia. Asia Pac J Public Health. 2015;27(2):123-35 PMID: 25524952. https://doi.org/10.1177/1010539514562447.
4. Ganasegeran K, Hor CP, Jamil MFA, et al. A systematic review of the economic burden of type 2 diabetes in Malaysia. Int J Environ Res Public Health. 2020;17(16) 5723. PMID: 32784771. PMCID: PMC7460065. https://doi.org/10.3390/ijerph17165723.
5. Protocol Medication Therapy Adherence Clinic: Diabetes, 2nd ed. Petaling Jaya: Pharmaceutical Services Division, Ministry of Health, Malaysia, 2014. https://www.pharmacy.gov.my/v2/sites/default/files/document-upload/buku-protocol-tac-diabetes-fa-ver2_0.pdf.
6. Dwiputri AW, Pristianty L, Hermansyah A. Pharmacist contributions in the treatment of diabetes mellitus in Southeast Asia: A narrative review. J Basic Clin Physiol Pharmacol. 2020;30(6):1-15. PMID: 31971912. https://doi.org/10.1515/jbcpp-2019-0322.
7. Capoccia K, Odegard PS, Letassy N. Medication adherence with diabetes medication: A systematic review of the literature. Diabetes Educ. 2016;42(1):34-71. PMID: 26637240. https://doi.org/10.1177/0145721715619038.
8. EndNote 20. London: Clarivate Analytics, 2020.
9. MedCalc® Statistical Software version 20.006. Ostend, Belgium: MedCalc Software Ltd., 2021.
10. Tricco AC, Lillie E, Zarin W, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and explanation. Ann Intern Med. 2018;169(7):467-73. PMID: 30178033. https://doi.org/10.7326/m18-0850.
11. Joanna Briggs Institute. Critical appraisal tools Melbourne: University of Melbourne; 2021. https://jbi.global/critical-appraisal-tools.
12. Abu Bakar Z, Fahrni ML, Khan TM. Patient satisfaction and medication adherence assessment amongst patients at the diabetes medication therapy adherence clinic. Diabetes Metab Syndr. 2016;10(2 Suppl 1):S139-43. PMID: 27055354. https://doi.org/10.1016/j.dsx.2016.03.015.
13. Amedy OS, Tang LY, Saido GA. Medication knowledge and adherence among type II diabetes mellitus patients: A cross sectional study. Malays J Nurs. 2018;10(2):24-33. https://doi.org/10.31674/mjn.2018.v10i02.003.
14. Al-Qazaz HK, Sulaiman SA, Hassali MA, et al. Diabetes knowledge, medication adherence and glycemic control among patients with type 2 diabetes. Int J Clin Pharm. 2011;33(6):1028-35. PMID: 22083724. https://doi.org/10.1007/s11096-011-9582-2.

15. Balasubramaniam S, Lim SL, Goh LH, Subramaniam S, Tangiisuran B. Evaluation of illness perceptions and their associations with glycaemic control, medication adherence and chronic kidney disease in type 2 diabetes mellitus patients in Malaysia. Diabetes Metab Syndr. 2019;13(4):2585-91. PMID: 31405680. https://doi.org/10.1016/j.dsx.2019.07.011.

16. Chew BH, Hassan NH, Sherina MS. Determinants of medication adherence among adults with type 2 diabetes mellitus in three Malaysian public health clinics: A cross-sectional study. Patient Prefer Adher. 2015;9:639-48. PMID: 25999699. PMCID: PMC4427255. https://doi.org/10.2147/ppa.s81612.

17. Chung WW, Chua SS, Lai PS, Morisky DE. The Malaysian Medication Adherence Scale (MALMAS): Concurrent validity using a clinical measure among people with type 2 diabetes in Malaysia. PLoS One. 2015;10(4):e0124275. PMID: 25909363. PMCID: PMC4409377. https://doi.org/10.1371/journal.pone.0124275.

18. Dhillon H, Nordin RB, Ramadas A. Quality of life and associated factors among primary care Asian patients with type 2 diabetes mellitus. Int J Environ Res Public Health. 2019;16(19):3561. PMID: 31547629. PMCID: PMC6801549. https://doi.org/10.3390/ijerph16193561.

19. Jannoo Z, Mamode Khan N. Medication adherence and diabetes self-care activities among patients with type 2 diabetes mellitus. Value Health Reg Issues. 2019;18:30-5. PMID: 30419448. https://doi.org/10.1016/j.vhri.2018.06.003.

20. Lai PSM, Sellappans R, Chua SS. Reliability and validity of the M-MALMAS Instrument to assess medication adherence in Malay-speaking patients with type 2 diabetes. Pharmaceut Med. 2020;34(3):201-7. PMID: 32436200. https://doi.org/10.1007/s40290-020-00335-y.

21. Nini Shuhaida MH, Siti Suhaila MY, Azidah KA, Norhayati NM, Nani D, Juliawati M. Depression, anxiety, stress and socio-demographic factors for poor glycaemic control in patients with type II diabetes. J Taibah Univ Med Sci. 2019;14(3):268-76. PMID: 31435416. PMCID: PMC6695081. https://doi.org/10.1016/j.jtumed.2019.03.002.

22. Abdullah MFILB, Sidi H, Ravindran A, et al. How much do we know about the biopsychosocial predictors of glycaemic control? Age and clinical factors predict glycaemic control, but psychological factors do not. J Diabetes Res. 2020;2020:2654208. PMID: 32455131. PMCID: PMC7222480. https://doi.org/10.1155/2020/2654208.

23. Al Abboud SA, Ahmad S, Bidin MB, Ismail NE. Validation of Malaysian versions of Perceived Diabetes Self-Management Scale (PDSMS), Medication Understanding and Use Self-Efficacy Scale (MUSE) and 8-Morisky Medication Adherence Scale (MMAS-8) using Partial Credit Rasch Model. J Clin Diagn Res. 2016;10(11):LC01-5. PMID: 28050405. PMCID: PMC5198358. https://doi.org/10.7860/jcdr/2016/15079.8845.

24. Lim PC, Lim K. Evaluation of a pharmacist-managed diabetes medication therapy adherence clinic. Pharm Pract (Granada). 2010;8(4):250-4. PMID: 25126149. PMCID: PMC4127064. https://doi.org/10.4321/s1886-36552010000400008.

25. Tan MY, Magarey J. Self-care practices of Malaysian adults with diabetes and sub-optimal glycaemic control. Patient Educ Couns. 2008;72(2):252-67. PMID: 18467068. https://doi.org/10.1016/j.pec.2008.03.017.

26. Tan MY, Magarey JM, Chee SS, Lee LF, Tan MH. A brief structured education programme enhances self-care practices and improves glycaemic control in Malaysians with poorly controlled diabetes. Health Educ Res. 2011;26(5):896-907. PMID: 21715653. https://doi.org/10.1093/her/cyr047.

27. Akoi C, Rahman MM, Abdullah MS. The relevant intervention strategies for improving medication adherence of diabetic patients. Int J Public Health Res. 2013;3(1):236-40. http://journalarticle.ukm.my/6132/1/vol_3_no_1_2013_31.pdf.

28. Azmi NL, Mustafa S, Muhamad Nor SH, Mohamad Zalik N. Adherence to prescribed medications among patients with chronic diseases. Int Res J Pharm Med Sci. 2020;3(5):22-6. http://irjpms.com/wp-content/uploads/2020/08/IRJPMS-V3N5P105Y20.pdf.

29. Selvadurai S, Makmor-Bakry M, Mhd Ali A. An explorative qualitative study on pharmacist active engagement approach in primary healthcare diabetic education. Indo J Pharm. 2020;31(3):193-204. https://doi.org10.22146/ijp.597.

30. Yean OB, Zhuang SY, Azmi AN. A prospective cohort study of medication beliefs and their impact on medication adherence in aboriginal and non-aboriginal patients. Malays J Med Health Sci. 2020;16(4):54-63. https://medic.upm.edu.my/upload/dokumen/2020120208290308_MJMHS_0132.pdf.

31. Sim YC, Mohd-Rosli IS, Lau BT, Ng SY. Patient satisfaction with medication therapy adherence clinic services in a district hospital: A cross-sectional study. Pharm Pract (Granada). 2021;19(2):2353. PMID: 34221203. PMCID: PMC8221750. https://doi.org/10.18549/pharmpract.2021.2.2353

32. Al-Qazaz HK, Hassali MA, Shafie AA, Syed Sulaiman SA, Sundram S. Perception and knowledge of patients with type 2 diabetes in Malaysia about their disease and medication: A qualitative study. Res Social Adm Pharm. 2011;7(2):180-91. PMID: 21272545. https://doi.org/10.1016/j.sapharm.2010.04.005.

33. Gillani SW, Sulaiman SAS, Abdul MIM, Saad SY. A qualitative study to explore the perception and behavior of patients towards diabetes management with physical disability. Diabetol Metab Syndr. 2017;9:58. PMID: 28770010. PMCID: PMC5525368. https://doi.org/10.1186/s13098-017-0257-6.

34. Gillani SW, Syed Sulaiman SA, Abdul MIM, Saad SY. Physical disability and diabetes mellitus: Qualitative exploration of patients' perception and behavior. Curr Diabetes Rev. 2018;14(5):472-80. PMID: 28699483. https://doi.org/10.2174/1573399813666170710183736.

35. Saidi S, Milnes LJ. Fatalism, faith and fear: A case study of self-care practice among adults with type 2 diabetes in urban Malaysia. J Clin Nurs. 2018;27(19-20):3758-67. PMID: 29893043. https://doi.org/10.1111/jocn.14559.

36. Al-Qazaz H, Hassali MA, Shafie AA, Sulaiman SA, Sundram S, Morisky DE. The eight-item Morisky Medication Adherence Scale MMAS: Translation and validation of the Malaysian version. Diabetes Res Clin Pract. 2010;90(2):216-21. PMID: 20832888. PMCID: PMC3109726. https://doi.org/10.1016/j.diabres.2010.08.012.

37. Butt M, Mhd Ali A, Bakry MM, Mustafa N. Impact of a pharmacist led diabetes mellitus intervention on HbA1c, medication adherence and quality of life: A randomised controlled study. Saudi Pharm J. 2016;24(1):40-8. PMID: 26903767. PMCID: PMC4720029. https://doi.org/10.1016/j.jsps.2015.02.023.

38. Chew BH. Medication adherence on quality of life among adults with type 2 diabetes mellitus: An exploratory analysis on the EDDMQoL study. Qual Life Res. 2015;24(11):2723-31. PMID: 26001640. https://doi.org/10.1007/s11136-015-1006-7.

39. Chew BH, Mohd Sidik S, Hassan NH. Association of diabetes-related distress, depression, medication adherence, and health-related quality of life with glycated hemoglobin, blood pressure, and lipids in adult patients with type 2 diabetes: A cross-sectional study. Ther Clin Risk Manag. 2015;11:669-81. PMID: 25995640. PMCID: PMC4425326. https://doi.org/10.2147/tcrm.s81623.

40. Chew BH, Vos RC, Pouwer F, Rutten G. The associations between diabetes distress and self-efficacy, medication adherence, self-care activities and disease control depend on the way diabetes distress is measured: Comparing the DDS-17, DDS-2 and the PAID-5. Diabetes Res Clin Pract. 2018;142:74-84. PMID: 29802952. https://doi.org/10.1016/j.diabres.2018.05.021

41. Chow EP, Hassali MA, Saleem F, Aljadhey H. Effects of pharmacist-led patient education on diabetes-related knowledge and medication adherence: A home-based study. Health Educ J. 2015;75(4):421-33. https://doi.org/10.1177/0017896915597021.

42. Hammad MA, Mohamed Noor DA, Syed Sulaiman SA. The effect of patients' adherence on HbA1c control. Arch Med Pharm Sci Res. 2017;1(1):30-5.

43. Jannoo Z, Wah YB, Lazim AM, Hassali MA. Examining diabetes distress, medication adherence, diabetes self-care activities, diabetes-specific quality of life and health-related quality of life among type 2 diabetes mellitus patients. J Clin Transl Endocrinol. 2017;9:48-54. PMID: 29067270. PMCID: PMC5651286. https://doi.org/10.1016/j.jcte.2017.07.003.

44. You LX, Selvadurai S, Yee CK, et al. Impact of pharmacist-managed diabetes medication therapy adherence clinic (DMTAC) in government health clinics. Malays J Pharm Sci. 2015;13(1):43-51. http://web.usm.my/mjps/mjps13012015/mjps13012015_4.pdf.

45. Tai CW. An evaluation on pharmacist-managed diabetes medication therapy adherence clinic (DMTAC) in primary health clinic of Johor Bahru district, Malaysia. Johor Health J. 2016;12:41-53.

46. Butt M, Ali AM, Bakry MM. Concurrent and longitudinal association between glycemic control and self reported medication adherence among type 2 diabetes patients at a tertiary care hospital in Malaysia. Curr Diabetes Rev. 2019;15(5):402-6. PMID: 30156163. https://doi.org/10.2174/1573399814666180828152754.

47. Chung WW, Chua SS, Lai PS, Chan SP. Effects of a pharmaceutical care model on medication adherence and glycemic control of people with type 2 diabetes. Patient Prefer Adherence. 2014;8:1185-94. PMID: 25214772. PMCID: PMC4159395. https://doi.org/10.2147/ppa.s66619.

48. Maruan K, Md Isa KA, Sulaiman N, Karuppannan M. Adherence of patients with type 2 diabetes to refills and medications: A comparison between 'telephone and collect' and conventional counter services in a health clinic. Drugs Ther Perspect. 2020;36:590–7. https://doi.org/10.1007/s40267-020-00776-0.

49. Sui CF, Chong TWS, Yip KY, Appalasamy M, Subramaniam AN, Mohan KV, et al. Adherence of type 2 diabetes mellitus (T2DM) patients towards antidiabetic medications (ADM) at outpatient department, Hospital Tapah: A cross sectional study using Adherence to Refills and Medications Scale for Diabetes (ARMS-D). Perak Med J. 2021. https://myjms.mohe.gov.my/index.php/pmj/article/view/8167.

50. Abdullah NF, Khuan L, Theng CA, Sowtali SN, Juni MH. Effect of patient characteristics on medication adherence among patients with type 2 diabetes mellitus: A cross-sectional survey. Contemp Nurse. 2019;55(1):27-37. PMID: 30764733. https://doi.org/10.1080/10376178.2019.1583067.

51. Ahmad NS, Islahudin F, Paraidathathu T. Factors associated with good glycemic control among patients with type 2 diabetes mellitus. J Diabetes Investig. 2014;5(5):563-9. PMID: 25411625. PMCID: PMC4188115. https://doi.org/10.1111/jdi.12175.

52. Ahmad NS, Ramli A, Islahudin F, Paraidathathu T. Medication adherence in patients with type 2 diabetes mellitus treated at primary health clinics in Malaysia. Patient Prefer Adherence. 2013;7:525-30. PMID: 23814461. PMCID: PMC3693921. https://doi.org/10.2147/ppa.s44698.

53. Azmi NL, Md Rosly NA, Tang HC, Che Darof AF, Zuki ND. Assessment of medication adherence and quality of life among patients with type 2 diabetes mellitus in a tertiary hospital in Kelantan, Malaysia. J Pharm. 2021;1(2):79-86. https://doi.org/10.31436/jop.v1i2.66.

54. Selvadurai S, Cheah KY, Ching MW, et al. Impact of pharmacist insulin injection re-education on glycemic control among type II diabetic patients in primary health clinics. Saudi Pharm J. 2021;29(7):670-6. PMID: 34400860. PMCID: PMC8347656. https://doi.org/10.1016/j.jsps.2021.04.028.

55. Yong SY, Goh GM, Loh HH. Insulin adherence and the associated factors among patients with type 2 diabetes mellitus at the Hospital Queen Elizabeth II, Sabah. J Public Health. 2020:1-9. https://doi.org/10.1007/s10389-020-01409-6.

56. Gillani SW, Ansari IA, Zaghloul HA, et al. Predictors of health-related quality of life among patients with type II diabetes mellitus who are insulin users: A multidimensional model. Curr Ther Res Clin Exp. 2019;90:53-60. PMID: 31193026. PMCID: PMC6514425. https://doi.org/10.1016/j.curtheres.2019.04.001.

57. Hatah E, Rahim N, Makmor-Bakry M, et al. Development and validation of Malaysia Medication Adherence Assessment Tool (MyMAAT) for diabetic patients. PLoS One. 2020;15(11):e0241909. PMID: 33157549. PMCID: PMC7647074. https://doi.org/10.1371/journal.pone.0241909.

58. Goh SSL, Lai PSM, Liew SM, Tan KM, Chung WW, Chua SS. Development of a PATIENT-Medication Adherence Instrument (P-MAI) and a HEALTHCARE PROFESSIONAL-Medication Adherence Instrument (H-MAI) using the nominal group technique. PLoS One. 2020;15(11):e0242051. PMID: 33175871. PMCID: PMC7657514. https://doi.org/10.1371/journal.pone.0242051.

59. Ting CY, Ahmad Zaidi Adruce S, et al. Effectiveness of a pharmacist-led structured group-based intervention in improving medication adherence and glycaemic control among type 2 diabetes mellitus patients: A randomized controlled trial. Res Social Adm Pharm. 2021;17(2):344-55. PMID: 32327398. https://doi.org/10.1016/j.sapharm.2020.03.026.

60. Ishak NH, Mohd Yusoff SS, Rahman RA, Kadir AA. Diabetes self-care and its associated factors among elderly diabetes in primary care. J Taibah Univ Med Sci. 2017;12(6):504-11. PMID: 31435286. PMCID: PMC6694907. https://doi.org/10.1016/j.jtumed.2017.03.008.

61. Jamaludin TSS, Mohammad NM, Hassan M, Nurumal MS. Knowledge and practice on medication adherence among type II diabetes mellitus patients. Enferm Clin. 2021;31(Suppl 2):S372-6. https://doi.org/10.1016/j.enfcli.2020.09.028.

62. Nasir NM, Ariffin F, Yasin SM. Physician-patient interaction satisfaction and its influence on medication adherence and type-2 diabetic control in a primary care setting. Med J Malays. 2018;73(3):163-9. http://www.e-mjm.org/2018/v73n3/medication-adherence.pdf.

63. Lim PC, Chung YY, Tan SJ, et al. Comparing the cost, glycaemic control and medication adherence of utilizing patients' own medicines (POMs) versus usual dispensing among diabetic patients in an outpatient setting. Daru. 2021;29(1):125-32. PMID: 33538999. PMCID: PMC8149523. https://doi.org/10.1007/s40199-021-00389-6.

64. Rosli MR, Neoh CF, Wu DB, Hassan NW, Mahmud M, Rahimi A, et al. Evaluation of home medication review for patients with type 2 diabetes mellitus by community pharmacists: A randomised controlled trial. Pharm Pract (Granada). 2021;19(3):2397. PMID: 34621450. PMCID: PMC8455124. https://doi.org/10.18549/PharmPract.2021.3.2397.

65. Tey SW, Ibrahim MN, Ahmad R, Alias NM, Zahid MA. An evaluation of the impact of diabetes medication therapy adherence clinic (DMTAC) in Tangkak. Pharm Res Rep. 2020;3(1):35-41. https://research.pharmacy.gov.my/system/files/PRR3.1pp.35-41.pdf.

66. Alison C, Anselm S. The effectiveness of diabetes medication therapy adherence clinic to improve glycaemic control among patients with type 2 diabetes mellitus: A randomised controlled trial. Med J Malaysia. 2020;75(3):246-53. PMID: 32467540.

67. Iqbal MZ, Khan AH, Sulaiman SAS, Ibrahim A, Azmi N, Iqbal MS, et al. Effect of pharmacist-led Intervention on progression of diabetic complications at two tertiary care hospitals of Malaysia. J Pharm Bioallied Sci. 2021;13(2):193-8. PMID: 34349479. PMCID: PMC8291114. https://doi.org/10.4103/jpbs.JPBS_488_20.

68. Iqbal MZ, Khan AH, Sulaiman SAS, et al. Impact of pharmacist educational intervention on predictors of diabetic retinopathy among diabetic patients at two tertiary care hospitals in Malaysia. Lat Am J Pharm. 2021;40(4):682-9.

69. Iqbal MZ, Khan AH, Sulaiman SAS, et al. Pharmacist-led educational interventions on determinants of diabetic nephropathy among diabetic patients in Malaysia. Lat Am J Pharm. 2021;40(5):957-64.

70. Karunagaran L, Dewi LKM, Yee LH. Evaluation on the impact of diabetes – medication therapy adherence clinic (Diabetes-mtac) towards management of type 2 diabetes mellitus patients. Int J Med Toxicol Leg Med. 2018;21(3-4):162-6. https://doi.org/10.5958/0974-4614.2018.00058.X.

71. Khan AH, Iqbal MZ, Syed Sulaiman SA, Ibrahim A, Azmi N, Iqbal MS, et al. Impact of pharmacist-led educational intervention on predictors of diabetic foot at two different hospitals of Malaysia. J Pharm Bioallied Sci. 2021;13(1):108-15. PMID: 34084056. PMCID: PMC8142923. https://doi.org/10.4103/jpbs.JPBS_475_20.

72. Khan AH, Iqbal MZ, Syed Sulaiman SA, Ibrahim A, Binti Yusoff Azmi NS, Iqbal MS. Effect of pharmacist-led intervention on predictors of diabetic neuropathy at two different hospitals of Malaysia. J Pharm Pharmacogn Res. 2021;9(2):153-64.

73. Lau BT, Ismail SZ, Ng SY, Mohmmad N. Impact of pharmacist-led diabetes program on glycated hemoglobin and diabetes-related hospitalizations in a district-level hospital: A pilot retrospective cohort study. International Journal of Advancement in Life Sciences Research. 2018;1(2):26-36. https://doi.org/10.31632/ijalsr.2018v01i02.005.

74. Lim PC, Lim K, Embee ZC, Hassali MA, Thiagarajan A, Khan TM. Study investigating the impact of pharmacist involvement on the outcomes of diabetes medication therapy adherence program Malaysia. Pak J Pharm Sci. 2016;29(2):595-601. PMID: 27087103.

75. Morisky Medication Adherence Scale. http://www.moriskyscale.com/.

76. De Las Cuevas C, Peñate W. Psychometric properties of the eight-item Morisky Medication Adherence Scale (MMAS-8) in a psychiatric outpatient setting. Int J Clin Health Psychol. 2015;15(2):121-9. PMID: 30487829. PMCID: PMC6224788. https://doi.org/10.1016/j.ijchp.2014.11.003.

77. Moon SJ, Lee WY, Hwang JS, Hong YP, Morisky DE. Accuracy of a screening tool for medication adherence: A systematic review and meta-analysis of the Morisky Medication Adherence Scale-8. PLoS One. 2017;12(11):e0187139. PMID: 29095870. PMCID: PMC5667769. https://doi.org/10.1371/journal.pone.0187139.

78. Azharuddin M, Adil M, Sharma M, Gyawali B. A systematic review and meta-analysis of non-adherence to anti-diabetic medication: Evidence from low- and middle-income countries. Int J Clin Pract. 2021;75(11):e14717. PMID: 34378293. https://doi.org/10.1111/ijcp.14717.

79. Kennedy-Martin T, Boye KS, Peng X. Cost of medication adherence and persistence in type 2 diabetes mellitus: a literature review. Patient Prefer Adherence. 2017;11:1103-17. PMID: 28721024. PMCID: PMC5501621. https://doi.org/10.2147/PPA.S136639.

80. Jaam M, Awaisu A, Ibrahim MI, Kheir N. Synthesizing and appraising the quality of the evidence on factors associated with medication adherence in diabetes: A systematic review of systematic reviews. Value Health Reg Issues. 2017;13:82-91. PMID: 29073997. https://doi.org/10.1016/j.vhri.2017.09.001.

81. van Eikenhorst L, Taxis K, van Dijk L, de Gier H. Pharmacist-led self-management interventions to improve diabetes outcomes. A systematic literature review and meta-analysis. Front Pharmacol. 2017;8:891. PMID: 29311916. PMCID: PMC5735079. https://doi.org/10.3389/fphar.2017.00891.