Zahari HL[1], Abdul Ghani AA[2], Hurzaid A[1,3*]

[1]Biological Sciences Programme, School of Distance Education, Universiti Sains Malaysia, 11800 Minden, Pulau Pinang, Malaysia

[2]Tendong Health Clinic, 17030 Pasir Mas, Kelantan

[3]School of Biological Sciences, Universiti Sains Malaysia, 11800 Minden, Pulau Pinang, Malaysia

*Corresponding author
Amirah Hurzaid
amirahhurzaid@usm.my

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Association between Medication Possession Ratio (MPR) in Type 2 Diabetes Mellitus Patients and Glycosylated Haemoglobin (HbA1c) in Klinik Kesihatan Tendong, Kelantan: A Preliminary Study

***Abstract* – Background:** Diabetes mellitus is highly prevalent in Malaysia, affecting a sizeable portion of the population. The country faces a growing burden, with an estimated prevalence rate of around 18.3%. Several factors contribute to the non-adherence of diabetes medication including demographic factors, complex medication regimens, inadequate communication with healthcare providers and cultural beliefs. Identifying the major factor that led to non-adherence on medication should be prioritized to achieve good glycaemic control with a HbA1c target of less than 7% for most diabetic patients. **Objectives:** This study aims to identify the factors affecting patients' Medication Possession Ratio (MPR) and how MPR is associated with HbA1c outcomes from retrospective data collection. **Method:** A retrospective study was conducted on a selected sample of 300 individuals who attended Klinik Kesihatan Tendong from May to June 2023. Secondary data on MPR was extracted from the Pharmacy Information System (PhIS) while HbA1c outcomes were obtained from the National Diabetes Registry database. **Results:** The study successfully demonstrated significant association between MPR with HbA1c outcomes in the patients. Patients with good adherence accounted for the majority of the study population (N=80.5%) with HbA1c levels below 7. **Conclusion:** The use of MPR as a tool to determine medication adherence of patients was proven to have significant association with HbA1c outcomes.

***Keywords* –** *MPR, MRCI, age, HbA1c outcomes, diabetes mellitus*

1 INTRODUCTION

Diabetes mellitus (DM), also known as diabetes, is a complex heterogeneous metabolic disorder characterized by hyperglycemia, a physiologically abnormal condition specified by persistently high blood glucose levels (1). This metabolic dysregulation is a serious and chronic condition where blood glucose levels rise due to the body's inability to produce sufficient insulin, effectively use insulin, or both. This is associated with a steady decline in beta-cell activity associated and insulin resistance in adipose and muscular tissue. Diabetes is a major public health issue, and it is one of four priority noncommunicable diseases (NCDs) marked by the world leaders for action. Diabetes has been steadily increasing in both the number of cases and the prevalence over the last few decades. Even though diabetes is not a high-mortality disease, the disease itself has become a major risk factor for other causes of death and has a high attributable disability burden apart from causing the increases in risk of developing cardiovascular disease, kidney disease, and blindness. Diabetes and its complication have contributed to mortality cases of 6.7 million adults aged between 20-79 as published in International Diabetes Federation (2). The numbers correspond to 12.2% death cases from others causes in this age group. The same report also reported that Malaysia led the Western Pacific region in diabetes prevalence in 2018, with 16.8%, affecting approximately 3.6 million of the total adult population. Type 2 Diabetes Mellitus (T2DM) accounts for >90% of adult-onset DM cases in Malaysia, and making it the most common type of DM in the country, as stated in the Clinical Practice Guidelines for Management of T2DM in Malaysia. The fluctuation in T2DM was being driven by population ageing, economic development, and increasing urbanisation, which has led to even more sedentary lifestyles and increased consumption of unhealthy foods linked to obesity (3).

One of the ways to combat chronic illnesses include the life-long pharmacotherapy intervention. Extensive research and development were persistently conducted to provide medications with proven efficacies and positive benefit-to-risk profiles apart from the modification on drug distribution in the body to suit the patient daily lifestyle and reducing the side effects. However, maximum benefits of these drugs were mostly suppressed due to incompliance of the patient to adhere to the prescribed treatment regimen (4). Adherence is a key factor associated with the effectiveness of all pharmacological therapies but is particularly critical for medications prescribed for chronic conditions. Hence, enhancing the efficacy of adherence interventions could potentially exert a more significance influence on the overall health of the population than any advancements in specific medical treatments (5). Evaluating medication adherence and persistence in large population samples is crucial, not only for gaining a deeper comprehension of the factors linked to poor adherence and for effectively pinpointing individuals who require intervention, but also for assessing the clinical and economic consequences associated with inadequate adherence and persistence. Various methods are employed to evaluate patient adherence to therapy, categorized as direct and indirect assessments. Direct methods, like the use of biochemical measures to monitor drug levels or metabolites in blood or urine, while accurate, are often not applicable to all medications and can be cost-prohibitive and impractical for large-scale populations (6). As a result, indirect measures derived from electronic medication records and administrative data are increasingly favoured due to their greater availability (7). These indirect measures encompass metrics such as MPR and Proportion of Days Covered (PDC).

The MPR is a method used to calculate adherence based on pharmacy claims data. It is determined by dividing the total days' supply of medication by the number of days in the assessment period. It is important to note that MPR considers any excess medication supply, so if patients refill their medications early or have an oversupply of medications, the MPR value may go beyond 1.0 (equivalent to 100%) (8). In Malaysia, most public primary healthcare clinics have adopted the Pharmacy Information System (PhIS), an electronic medication management system that houses comprehensive patient data, including medication history, prescribed drug quantities, drug allergies, and MPR. The incorporation of this system has streamlined and facilitated the assessment of patient medication adherence.

The fraction of glycated haemoglobin or HbA1c, rises predictably in relation to the average level of plasma glucose. HbA1c was formed by non-enzymatic glycation of the beta chain of haemoglobin A by the plasma glucose (9). The glycation of these chains was irreversible and continuously occurred throughout the lifespan of red blood cells which lasted for 120 days or 3 months. As a result, it provides a three-month projection of blood sugar levels, with the most recent glucose measurements exerting the most significant impact on its calculation (10, 11). As per the Clinical Practice Guideline for T2DM, effective glycaemic control is defined as HbA1c levels below 7% for most patients, while a target of HbA1c ≤6.5% is recommended for those with a shorter duration of T2DM. The standardized HbA1c assay exhibits the least variability, 0.3% to 0.4%, in comparison to fasting (12%) and 2-hour plasma glucose level (20%) tests. What sets the HbA1c test apart is that it does not require individuals to fast or consume oral glucose, unlike the Fasting Blood Glucose (FBG) and Oral Glucose Tolerance Test (OGTT). Furthermore, HbA1c testing can be conducted at any time of the day, offering greater flexibility for individuals with busy schedules or transportation constraints, making it a more accommodating option for diabetes screening.

With the continued progress in healthcare, it is anticipated that global life expectancy will continue to increase, potentially reaching 77.2 years by the year 2050. Present assessments indicate that the population aged 65 and above comprises 2.3 million individuals, constituting 6.2% of the total population of 32.4 million. Malaysia is projected to witness a significant growth in its elderly population, more than doubling in size over the next 23 years (12). Unfortunately, the upsurge in life expectancy has been accompanied by a rising prevalence of NCDs, contributing to the growing elderly population's susceptibility to NCDs and age-related disabilities. This demographic shift is placing substantial demands on healthcare systems, which many are currently ill-equipped to handle effectively (13). For many elderly individuals, adhering to the prescribed medication regimen can prove to be a daunting challenge due to age-related changes in cognitive and functional abilities, as well as the complexity of their drug regimens (14). Research indicates that medication adherence tends to decline progressively with age

(15). Additionally, personal and cultural beliefs play significant roles in influencing medication adherence among older adults. Personal beliefs are reflective of an individual's understanding of their medical condition and the prescribed medications, while cultural beliefs encompass the societal influences on an individual. These beliefs have been identified as reasons why older individuals may become non-adherent to their medication, particularly when their health conditions lack noticeable symptoms (16). Furthermore, medication adherence among the elderly can also be influenced by beliefs related to the perceived necessity of the medication and concerns about potential side effects (17).

DM is often not a stand-alone type of chronic disease. This disease is usually accompanied with other chronic comorbidities, such as hypertension and dyslipidaemia. These chronic diseases require the long-term use of medications to control their progression which lead to the complexity of medication regimen. The complexity of medication regimens, along with the perceived burden of taking multiple medicines, has been identified as potential contributors to non-adherence in the context of chronic disease treatment (18). A complicated regimen, typically comprising multiple drugs, various dosage forms, complicated schedules, and the need for specific administration instructions, can pose obstacles to effective medication utilization and may undermine adherence to pharmacotherapy (19).

Several studies have reported that individuals with diabetes who are burdened by a complex medication regimen tend to experience unfavourable clinical outcomes and a diminished quality of life. For instance, in Brazil, patients with higher Medication Regimen Complexity Index (MRCI) scores, had lower ratings in physical, psychological, and overall quality of life domains (20, 21). The complexity of a medication regimen can be assessed by calculating the MRCI, which takes into account factors such as the number of medications, dosage forms, dosing frequencies, and any additional administration instructions (22).

A retrospective study utilizes existing data or records to examine relationships between variables. In this study, our focus is on investigating the association between factors influencing MPR and HbA1c outcomes. Research and exploration of medication regimens, patients' perceptions, and behaviours are necessary to ensure that suggested regimens fully benefit the patients. Research questions include:

(a) What is the association between high medication adherence and targeted HbA1c levels?
(b) How does adherence relate to patients' age?
(c) What is the relationship between medication complexity and patient adherence?

2 METHODOLOGY

2.1 Study Design and Population

This retrospective study was conducted at Klinik Kesihatan Tendong in Pasir Mas, Kelantan, during the period from May to June 2023. This primary healthcare clinic offers outpatient services to individuals with various chronic conditions, including T2DM, within the Pasir Mas subdistrict. The clinic has implemented the Enhanced Primary Healthcare Program (EnPHC), which aims to enhance the quality of healthcare services while optimizing the use of existing infrastructure and healthcare personnel. The clinic is equipped with a team comprising a family medicine specialist, multiple diabetes educators, and various healthcare professionals providing primary diagnostic services. Additionally, the facility boasts certified pharmacists trained in diabetes education, ensuring comprehensive and specialized care for diabetes management.

The inclusion criteria for the sample selection encompass patients aged 20 and above, with T2DM, who are undergoing regular follow-up at Klinik Kesihatan Tendong and exhibit normal cognitive function. The sample for this study was chosen using a simple random sampling method. Conversely, certain exclusion criteria have been implemented. Patients with Stage 5 chronic kidney disease and those with missing or incomplete data in either the PhIS or the National Diabetes Registry (NDR) are excluded from the study.

A total of 300 samples were organized into age categories to explore the relationship between age and MPR. Each category represented a 10-year age interval, with the first category encompassing individuals aged 31-40, and the last category including those aged 81-90. The complexity of the medication regimen was assessed using the Medication Regimen Complexity Index (MRCI). This index relies on four distinct components, each assigned its own weightage that collectively contribute to the overall calculation. These components comprise the number of medications, the dosing form, the dosing frequency, and any additional administration instructions.

2.2 Sample Size Determination
The sample size was determined utilizing the single proportion formula, considering a 95% confidence interval (CI) and a 5% margin of error, while estimating the sample proportion to be approximately 50%.

2.3 Study Procedure
Data collection involved retrieving patient records from the clinic. Initially, a screening process was implemented to identify T2DM patients aged 20 and above. Subsequently, an additional screening step was carried out to identify individuals meeting the exclusion criteria, which encompassed those with Stage 5 chronic kidney disease and individuals with missing or incomplete data in either database. After this sorting process, the MPR of the patients was compared to their respective HbA1c levels. All the relevant data were organized and separated using Microsoft Excel before undergoing analysis in IBM SPSS Version 28.

2.4 Study Instrument
Currently, there is no universally accepted standard tool for evaluating medication adherence. Several options exist, including the use of pill counters, medication diaries, and electronic prescription refill databases. Adherence questionnaires are another approach, although they may be susceptible to participant bias and provide potentially inaccurate data. In this study, the researchers opted for a different method by utilizing medication records from an easily accessible electronic database. This approach leveraged the readily available MPR score obtained from the PhIS database. The MPR data were then compared with the patients' HbA1c records from the National Diabetes Registry (NDR) database. Additionally, patient age and a comprehensive list of medications, including details on frequency, dosage forms, and any special instructions, were extracted from the PhIS database. This information was essential for assessing the complexity of the medication regimen.

2.5 Data Analysis
Data analysis was performed using SPSS version 28.0 for Windows. Categorical data, such as age and MPR score, were summarized using frequencies and percentages, while numerical data, like HbA1c levels and MRCI, were presented as means with standard deviations. Correlation coefficients were computed to explore relationships in the data, specifically examining associations between MPR and HbA1c outcomes, age and MPR, and MRCI and MPR. Variables with p-values below 0.05 were deemed statistically significant.

2.6 Ethical Consideration
Ethical approval for this study was obtained from Jawatankuasa Etika Penyelidikan Manusia (JEPeM) Universiti Sains Malaysia (USM/JEPeM/PP/23030242) and Medical Research and Ethics Committee, National Institute of Health Malaysia (NMRR ID-23-00960-LJ7).

3 RESULTS

3.1 Patients' Demographic
A total of 300 samples that met the inclusion criteria, and did not meet any exclusion criteria were selected for this study. The results of demographic distribution reveal that the sample predominantly consists of female participants, accounting for 72.3% of the sample, while males represent 27.7%. In terms of age categories, the highest number of participants falls within the 61-70 age-group, with a total of 106 individuals (Table 1).

3.2 Medication Possession Ratio (MPR)
Table 2 presents the scores for MPR categories alongside their corresponding frequencies. A score of ≥80% indicates good medication possession, while a score of <80% suggests poor medication possession. The distribution of participants between these two categories is almost equal, demonstrating a relatively balanced representation. According to Figure 1, each age categories exhibited nearly equal number of good and poor MPR. However, the age group of 61-70 stood out with a significantly higher number of individuals having MPR ≥80.

3.3 HbA1c Outcomes
Table 3 reveals that the percentage of HbA1c scores ≥7 is higher compared to scores <7. HbA1c scores <7 indicate controlled diabetes, while scores ≥7 suggest uncontrolled diabetes. Figure 2 illustrates the distribution of samples for the classification of HbA1c within each age category. The results show that the age categories of 71-80 and 81-90 have a higher number of individuals with HbA1c <7 than those with HbA1c ≥7.

3.4 Association Between MPR and HbA1c

Table 4 provides a description of the statistical correlation between HbA1c and MPR. The association was found to be significant at the 0.01 level. A graphical representation of this association between the two variables is shown in Figure 3. The scatter plot clearly shows a significant negative correlation, with the gridline indicating that higher MPR scores are strongly associated with lower HbA1c outcomes.

3.5 Association Between Age Group and MPR Scores

Table 5 presents the statistical relationship between the age group and MPR scores. Results show that there is no significant association between these variables (p-value>0.05).

3.6 Association Between MRCI and MPR

According to Table 6, the MPR and MRCI have a weak negative correlation. However, there was no statistically significant correlation between MPR and MRCI ($r = -0.043$, $p>0.05$).

4 DISCUSSIONS

The study was conducted at Klinik Kesihatan Tendong, the only clinic in the Pasir Mas district implementing the Enhanced Primary Healthcare Program (EnPHC) during the study period. This program aims to enhance healthcare quality using existing infrastructure and personnel. Klinik Kesihatan Tendong features a team that includes a family medicine specialist, multiple diabetes educators, and various healthcare professionals providing primary diagnostic services. It also has certified pharmacists trained in diabetes education, ensuring comprehensive care for diabetes management. The clinic was chosen due to its high number of patients registered with the National Diabetes Registry (NDR). While this clinic may not represent the overall situation in Malaysia, particularly in larger cities like Selangor, Penang, and Johor Bahru, the data obtained can serve as a pilot study for future research in clinics with more patients. Additionally, the first author is part of the clinic's care team, facilitating easier patient data selection due to prior knowledge of patients meeting the study's exclusion criteria.

In this study, a significant association between MPR scores and patients' HbA1c outcomes was observed ($p<0.05$). These findings align with a study conducted by researchers at the Pagoh Health Clinic (23), where patients with higher adherence to diabetic medication exhibited better glycaemic control (mean HbA1c level: 7.9 ± 1.9%) in comparison to non-adherent patients (mean HbA1c level: 8.7 ± 2.1%). Equivalent results were reported by another study (24) at Hospital Pulau Pinang, showing that 46.7% of patients with good medication adherence (MMAS score 76-100%) had controlled diabetes, while only 16.9% of non-adherent cases achieved controlled HbA1c levels. T2DM patients with higher adherence had twice the odds of achieving good glycaemic control compared to those who were non-adherent.

Rhee et al. (25) reported a 0.34% decrease in HbA1c levels for every 25% increase in medication adherence. Individuals who maintained glycaemic control, defined as having all HbA1c values below 7% in the post-period, were less likely to be diagnosed with most diabetes-related comorbidities during that period compared to those with sustained sub-optimal glycaemic control, defined as having all HbA1c values at or above 7% in the post-period. Maintaining an HbA1c level of 7% over a 5-year period was associated with a significantly lower likelihood of being diagnosed with cardiovascular disease, metabolic disease, neuropathy, nephropathy, and peripheral vascular disease (26). Patients with chronic medical conditions who adhered to their medication reported better overall health conditions and quality of life (27). Meta-analyses of clinical trials examining intensive glycaemic control showed a lower risk of composite microvascular outcomes or specific microvascular endpoints like nephropathy (28–30).

In addition to its impact on individual health, higher medication adherence has been shown to influence healthcare costs. Patients who adhere to their medication regimens often incur higher pharmacy expenses. However, these increased pharmacy costs are more than compensated for by substantial savings in other areas, primarily related to reduced inpatient admissions. As a result, individuals with the highest adherence levels experienced lower total healthcare expenditures, encompassing inpatient, outpatient, emergency room, and pharmacy expenses, compared to those with the lowest adherence levels (31). A study conducted in the United States by Kleinmen et al. (32) focusing on insulin adherence found that incremental increases in MPR were associated with cost savings.

In Malaysia, the adherence to diabetes medication is alarmingly low, with a rate of only 34.4% (33). This finding underscores that at least one-third of Malaysian diabetes patients are not taking their prescribed medication as directed, a

trend consistent with data from other low and middle-income countries (34). Despite substantial spending and resource allocation towards pharmacological treatments, the glycaemic control of patients with T2DM in Malaysia is generally suboptimal (35). The rising prevalence of T2DM is a major concern for governments and healthcare providers, as individuals with this condition are at a significantly higher risk of developing comorbid conditions compared to those without T2DM (36).

Based on the results presented, neither MRCI nor age categories demonstrated a linear association with MPR scores, contrary to the initial predictions made at the outset of this study. However, it is worth noting that there could be a non-linear relationship between these two factors and MPR scores. The factors contributing to poor MPR scores, which reflect patients' adherence to their medication, remain a subject of conflicting findings in numerous studies. Smaje et al. (37) reported a negative association between older age and medication non-adherence. In contrast, a study by Kirkman et al. (38), based on a large pharmacy database, found higher adherence to medication among the elderly (ages 65-74) compared to younger patients (ages 45-64).

Cognitive impairment is a significant factor contributing to non-adherence among older individuals (39). Johnell (40) concluded that the prevalence of non-adherence in patients with cognitive impairment and dementia ranges from 10.2% to 56.4%. Another factor that introduces complexity is the uneven distribution of the study population across age categories. Notably, the age category 61-70 constitutes the largest proportion at 35.3%, while the age categories 81-90 and 31-40 represent only 3% and 4% of the study population, respectively. Additionally, as reported by Smaje et al. (37), the number of medications has a negative association with medication adherence. This supports the notion that a burdensome medication regimen can impede flexibility in daily life (41). The number of medications prescribed to patients is typically influenced by the severity of their disease condition and the presence of comorbidities. A survey conducted in the United States revealed that 50% of diabetic patients were prescribed more than seven medications, which can pose challenges for adherence.

However, this study did not identify a linear association between medication regimen complexity and MPR scores. Similar finding was observed by Ahmad et al. (42) who conducted their study in seven Primary Health Clinics located in Hulu Langat, Selangor, where the number of medications did not correlate with MPR scores. Confounding factors that may have influenced the results of this study include the presence of caregivers and the health literacy of the patients themselves. Notably, achieving satisfactory treatment adherence in patients with dementia often relies on the presence of caregivers (43). Prominent levels of social support, especially from family members, have been shown to improve treatment adherence (44).

Furthermore, patients' own health literacy played a significant role in achieving an MPR of ≥80%. The Diabetes Mellitus Medication Therapy Adherence Clinic (DMTAC), established by the Pharmaceutical Service division in 2004, aimed to enhance medication adherence and glycaemic control in T2DM patients (45). Continuous participation in DMTAC showed a significant difference between the mean baseline HbA1c level and HbA1c outcomes after the eighth visit (46). Although the difference in mean HbA1c levels between shorter appointment intervals and longer appointment intervals was observable, it did not reach statistical significance (p=0.548) (46). Another study reported a significant improvement in HbA1c outcomes (mean = -1.58) in the intervention group compared to the control group (mean= -0.48) (47).

5 CONCLUSION

The utilization of the MPR score in identifying medication adherence has demonstrated a significant association with HbA1c outcomes, which in turn reflects the glycaemic control in patients. Despite the introduction of multiple approaches aimed at improving glycaemic control in the population, the success rate remains below 50%. It is crucial to enhance and make easily accessible those approaches that patients can readily implement. Identifying the factors contributing to medication non-adherence can provide valuable insights into this problem. The data obtained from this study demonstrated that uncontrolled HbA1c is higher than that of patients with controlled HbA1c (N=57.7%). This trend increases the number of diabetic patients with multiple comorbidities within Malaysia's primary care settings. The localized social, economic, and public health consequences on the community are still uncertain at present, but the data from NHMS 2019 indicates a potentially higher monetary impact on managing diabetes if this trend continues.

Table 1. The demographic distribution of the patients

Gender	Frequency, N (%)
Female	217 (72.3)
Male	83 (27.7)
Age categories	
31-40	12 (4)
41-50	23 (7.7)
51-60	87 (29)
61-70	106 (35.3)
71-80	61 (20.3)
81-90	11 (3.7)

Table 2. The scores for MPR categories and their frequencies

MPR categories	Frequency, N (%)
≥80%	167 (55.7)
<80%	133 (44.3)

Table 3. The HbA1c scores and their frequencies

HbA1c scores	Frequency, N (%)
<7	127 (42.3)
≥7	173 (57.7)

Table 4. Correlation analysis between MPR scores and HbA1c outcomes

		HbA1c	MPR
HbA1c	Pearson correlation	1	-0.326*
	Sig. (2-tailed)		0.000
	N	300	300
MPR	Pearson correlation	-.326**	1
	Sig. (2-tailed)	0.000	
	N	300	300

	MPR	
	r	*p* value*
HbA1c	-0.326	< 0.001

*Correlation is significant at the 0.01 level (2-tailed)

Table 5. The correlation between the age group of patients and their corresponding MPR scores

		MPR	AGE GROUP
MPR	Pearson correlation	1	0.047
	Sig. (2-tailed)		0.418
	N	300	300
Age group	Pearson correlation	0.047	1
	Sig. (2-tailed)	0.418	
	N	300	300

	MPR	
	r	*p* value*
Age group	0.047	> 0.050

*No significant association between the two variables

Table 6. Association between MPR and MRCI scores of patients

		MPR	MRCI
MPR	Pearson correlation	1	-0.043
	Sig. (2-tailed)		0.455
	N	300	300
MRCI	Pearson correlation	-0.043	1
	Sig. (2-tailed)	0.455	
	N	300	300

	MPR	
	r	*p* value*
MRCI	-0.043	> 0.050

*Negative insignificant linear correlation

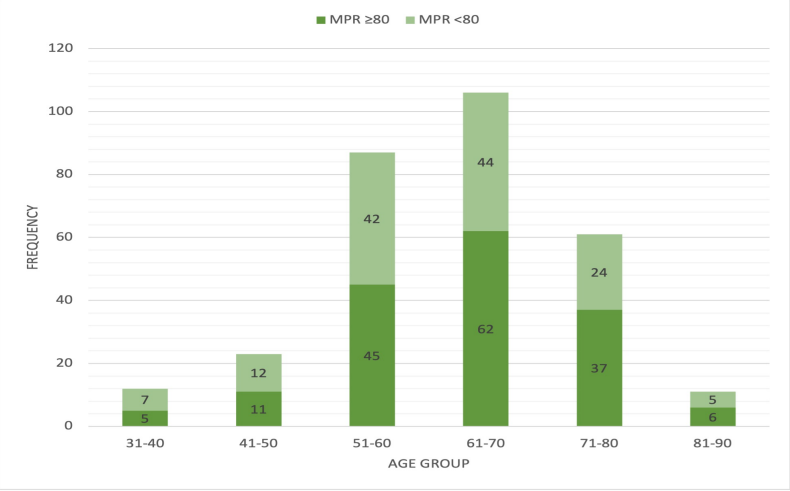

Figure 1. The categories of MPR scores according to the age group

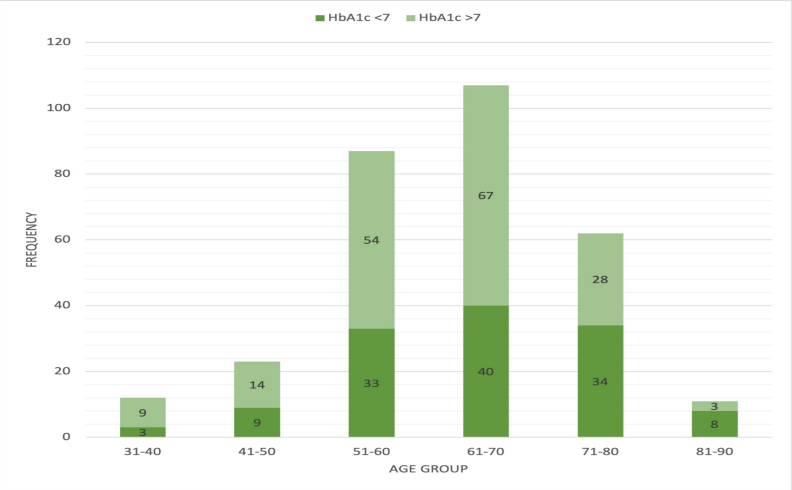

Figure 2. The categories of HbA1c outcomes according to age group

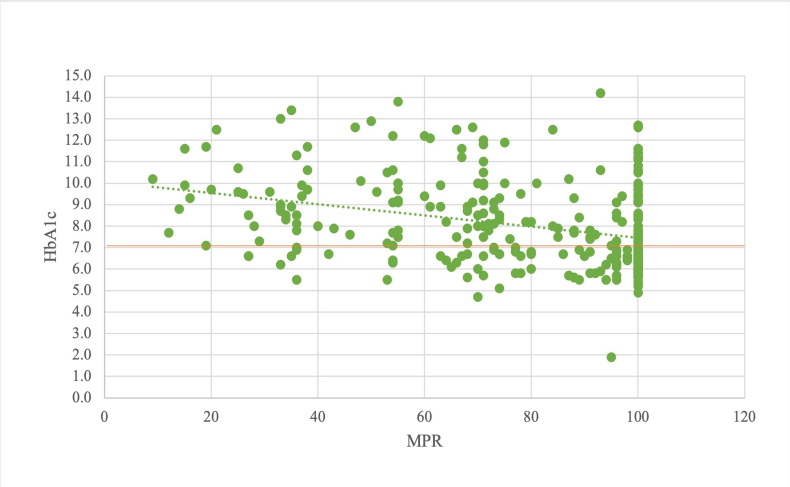

Figure 3. The association between MPR scores and HbA1c levels

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CONFLICTS OF INTEREST

The authors declare no conflict of interest in this study.

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LIMITATION OF STUDY

This study had some limitations that may have influenced the findings. First, this is a retrospective study. Biases such as documentation may have been introduced due to insufficient or inaccurate original medical record charting or data entry by data abstractors. Despite the use of rigorous simple random selection, this study did not include all T2DM patients.

Only 300 patients from Klinik Kesihatan Tendong who met the inclusion criteria were chosen. As selected study design is quantitative, the insights into the qualitative aspects of non-adherence to the recommended guidelines may be limited.

The use of Pharmacy Information System (PhIS) for extracting data on supplies of medication also became the drawback of this study. Although PhIS already ease the data collection where MPR would be easily generated on specific features, this feature was found to be less approximate when compared with different features that displayed the balanced and undispensed quantity for each refill date. This might happen due to incomplete innovation on software for catching data according to visit. The use of MRCI calculator might also affect the result in some way. The guide for weightage for each item and category was not displayed next to the calculator and might gave different result than actual values intended. Other than that, as this study design is retrospective data study, collection of data from PhIS is limited for the real-life scenario where patients might refuse the medication during dispensing.

Limitation to the secondary source of data set caused other multiple confounding variables such as balanced medication supply, visit to other health facilities, patients' demographic profiles, contraindication to various medications, prescriber's characteristic (e.g., education, working experience) or patient own preference on DM medications. Qualitative factors that might became the determinant of MPR score cannot be identified from this study.

The progressive development of medication has led to attainable changes in medication prescribing and administration. Drugs were design to provide more convenient to be administered with fewer side effects. Combination therapy in single dosage form and modified released drug was made available in the facility's formulary but with limited quantity. Continuous medical training apart from other related courses held for healthcare providers had encourage better approaches in dealing and managing patients with DM. This situation might contribute to trend of adherence and glycaemic control of the patients.

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