

Medication Adherence of Oral Hypoglycemics among Type-2 Diabetes Patients and Factors Affecting It – A Cross Sectional Study**Lakshmi Deepika Patchva¹, Sirisha Annavarapu², G. Santhi³, B. Chandrika Raj⁴**¹Assistant Professor, Department of Pharmacology, DY Patil Medical College, Kolhapur, Maharashtra, India²Associate Professor, Department of Pharmacology, Dr. Pinnamaneni SIMS & RF, Chinnaoutpalli, A.P., India³Tutor, Department of Pharmacology, Dr. Pinnamaneni SIMS & RF, Chinnaoutpalli, A.P., India⁴Intern, Dr. Pinnamaneni SIMS & RF, Chinnaoutpalli, A.P., India

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Abstract

Medication adherence is essential for achieving optimal glycaemic control and preventing complications in patients with type 2 diabetes mellitus (T2DM). However, long-term adherence to oral hypoglycaemic agents remains challenging and may be influenced by patient-, medication-, and healthcare-related factors. This study aimed to assess medication adherence among patients with T2DM receiving oral hypoglycaemic agents and to identify factors affecting adherence.

Methods: A hospital-based cross-sectional study was conducted over 12 months among 400 patients with T2DM receiving oral hypoglycaemic medications. Participants attending the outpatient and inpatient departments of General Medicine and Endocrinology of Dr. PSIMS & RF were recruited using purposive sampling. Socio-demographic characteristics, clinical details, medication-related factors, and healthcare-related factors were collected using a semi-structured questionnaire. Medication adherence was assessed using the eight-item Morisky Medication Adherence Scale (MMAS-8). Data were analysed using Microsoft Excel and IBM SPSS version 21. Descriptive statistics were used to summarise the data.

Results: Among the 400 participants, 59% were female and 41% were male, with the largest proportion aged 50–59 years (36%). Most participants were receiving a single prescribed medication (73%), and 48% reported taking medication once daily. Forgetfulness was reported by 17% of participants, while 13% identified medication cost as a factor affecting adherence. Regular follow-up was reported by 77% of participants, whereas 56% reported using alternative medications. MMAS-8 responses demonstrated that forgetfulness, missed doses, travel, perceived disease control, and inconvenience associated with daily medication were important barriers to adherence.

Conclusion: Medication adherence among patients with T2DM receiving oral hypoglycaemic agents is influenced by multiple patient-, medication-, and healthcare-related factors. Identification of individual barriers and targeted patient education and counselling may help improve medication adherence and support effective long-term diabetes management.

Keywords: Medication Adherence, Type 2 Diabetes, Oral Hypoglycaemic Drugs, Factors Affecting.

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Introduction

One of the main factors influencing the success of treatment is adherence to medicines. Non-compliance is a severe issue that impacts the patient as well as the healthcare system. Patients who don't take their medications as prescribed experience significant illness progression, mortality, and higher medical expenses. Adherence may be impacted by a number of things. Adherence barriers may be resolved as a result of interactions between patient, provider, and health system

factors. Improving medicine adherence will require identifying unique obstacles for each patient and implementing appropriate strategies to get beyond them. [6] Medication non-adherence is largely disregarded, despite the fact that it results in an estimated 125 thousand premature deaths yearly and \$100 billion in wasteful healthcare expenses. [7] A major and quickly expanding public health issue that impacts millions of people is diabetes mellitus (DM). It typically coexists with other

medical conditions, and each year its frequency rises to epidemic proportions. There are 387 million people with DM at the moment, and that number is predicted to rise to 483 million and 592 million by 2030 and 2035 respectively. In developing countries, diabetes accounts for almost 77% of morbidities and 88% of fatalities [1,2].

As numerous diabetes-related consequences, including neuropathy, renal disease and blindness, which make it challenging to keep patients motivated for long-term treatment. As a result, many patients miss frequent doctor appointments or don't take their medications as prescribed.

The WHO defines adherence for long-term treatment as "the extent to which a person's behavior – taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a health care provider". According to the WHO report, the average adherence to long-term therapy for chronic diseases in developed countries is approximately 50%, and in developing countries the adherence rate is even lower. [3]

Poor medication adherence leads to worsening of the disease and increased mortality, and imposes a significant financial burden on both the individual patient and the health care system. Globally, diabetes accounts for 11% of total health care expenditure in 2011. [3]

The eight-item Morisky Medication Taking Adherence Scale (MMAS), one of the various medication adherence approaches, rates the level of adherence. This scale's benefits include being brief, being the quickest to administer, being the simplest to score, identifying non-adherence hurdles, being widely used in a variety of conditions, and being the most population-adaptable, which reduces the response burden. [3,5]

In type 2 diabetes (T2D), at least 45% of individuals do not attain appropriate glycemic control ($HbA1c < 7\%$). Poor adherence to medicine is one of the main contributing causes. It is widely known that poor medication adherence is extremely common in people with type 2 diabetes and is linked to poor glycemic control, higher rates of morbidity and death, and higher expenses for outpatient care, ER visits, hospital stays, and treating diabetic complications. [10]

T2D is approaching epidemic proportions over the world, and the incidence and prevalence of T2D are increasing. Indeed, the global prevalence of type 2 diabetes is anticipated to rise from 382 million to more than 417 million by 2035. [10]

According to the India Diabetes study, there are approximately 77 million people in India who have pre-diabetes and 62.4 million who have type 2

diabetes; by 2030, this number is expected to increase to 101 million [10]. Therefore, with a frequency that ranges from 5.6% in rural regions to 12.1% in big cities, India is regarded as the "diabetes capital of the world". [5] In 2013, diabetes was the leading cause of death in the region, accounting for 1,065,052 deaths. High blood glucose was the primary cause of 2.2 million fatalities in 2012, while diabetes was the direct cause of 1.6 million deaths in 2016 alone. [10-12]

Patients with T2DM require long-term use of diabetic medication. Although studies have demonstrated that employing anti-diabetic drugs can help treat T2DM patients, medication adherence remains a concern. [14] A study conducted in Tanzania, for example, found that 34.3% of T2DM patients had poor treatment adherence. [15] Another investigation in Botswana found that 41.8% of T2DM patients did not adhere to their anti-diabetic drugs. [16] In 2021, Islam et al. [11] found a 48.2% prevalence of poor medication adherence among those suffering from T2DM in Bangladesh. [17] Low drug adherence is a serious problem in T2DM patients, and studies have shown that it typically worsens with time after treatment commencement. [14, 18-20].

In its seminal report on non-adherence worldwide, the WHO estimated that 50% of people took their T2DM prescriptions as prescribed. It also noted that, due to resource constraints, adherence was more likely to be lower in nations with lower incomes. As a result, between 36 and 93% of people do not take their anti-diabetic drugs as prescribed. This can change blood glucose levels and result in issues that lower quality of life. [21]

Adherence can be measured either directly or indirectly, based on the concentration of the drug or its metabolite in blood and urine, the presence of a biological marker supplied with the medicine, and observation of the patient's medication-taking behavior, or using numerous questionnaires. Even though they are less reliable than direct assessment, questionnaire surveys with validated scales are easier to execute and hence more acceptable for the evaluation of larger patient populations in a community context. [22]

Among the few accessible medication adherence scales, the Morisky Medication Adherence Scale (MMAS) is the most widely used. The Morisky, Green and Levine (MGL) Medication Adherence Scale was first created as a four-item scale with "yes" or "no" response categories. However, since 2008, it has also been offered in an eight-item version (MMAS-8), which in addition to seven binary statements also includes one that is scored on a five-point Likert-type scale. [22]

Non-adherence is caused by a number of circumstances, such as costs, literacy, ignorance, and insufficient support from family/ community. Multiple disorders and polypharmacy among older adults are significant barriers to drug adherence. Medication compliance is hampered by cultural norms and also influenced by forgetfulness brought on by mental illness. According to the Cochrane Review, a lack of a comprehensive grasp of the adherence issues is one reason for non-effectiveness. [7]

Furthermore, non-adherence is influenced by the long duration of medication use, the side effects of anti-diabetic drugs such as fatigue, nausea, vomiting, psychological problems, and itching, socio-cultural issues, substance use, belief, the availability and affordability of medicines, and non-persistence. Previous research has revealed non-adherence factors such as poorer treatment outcomes, low demographic features (such as youth, low education, and income), disease symptom progression, and comorbidities including hypertension, which typically raise medical costs, inadequate medical facilities, and a lack of health insurance, are other variables that contribute to low drug adherence.[21]

The purpose of this study was to identify how many patients are adhered to the prescribed medication / treatment and what factors are affecting to their non-adherence by using the MMAS-8.

Aim & Objective:

1. To study medication adherence of oral hypoglycemics among patients with Type 2 diabetes, and
2. To study factors affecting medication adherence among type 2 diabetes patients.

Methodology:

Study Design: A Cross –Sectional Study.

Sample Size: 400.

Sampling Method: Purposive sampling.

Study Duration: 12 months.

It is a cross-sectional questionnaire based study performed for 12 months period among type 2 diabetes patients who are on Oral hyoglycemic drugs & attending the outpatient, or admitted as inpatient in Department of General Medicine & Endocrinology at Dr. PSIMS & RF.

The Institutional ethics committee provided ethical approval for the study's execution. Every

participant gave their written informed consent after being fully briefed about the study.

In this survey, a semi-structured questionnaire was provided to participants in English and local language (telugu). The forms are filled using a self-administered method while they were at the hospital. All participants filled out a self-report questionnaire based on study variables such as age, gender, residence, marital status, education level, and occupational status, as well as a clinical profile (disease type, disease duration, current medications, and any other comorbidity). Adherence to diabetes medications was measured using the 8 -item Morisky Medication Taking Adherence Scale (MMAS).

Inclusion Criteria: The participants with known diabetes, and had been taking diabetes oral medications were included.

Exclusion Criteria: Diabetic patients on parenteral medications (insulin) & Non-diabetic patients,

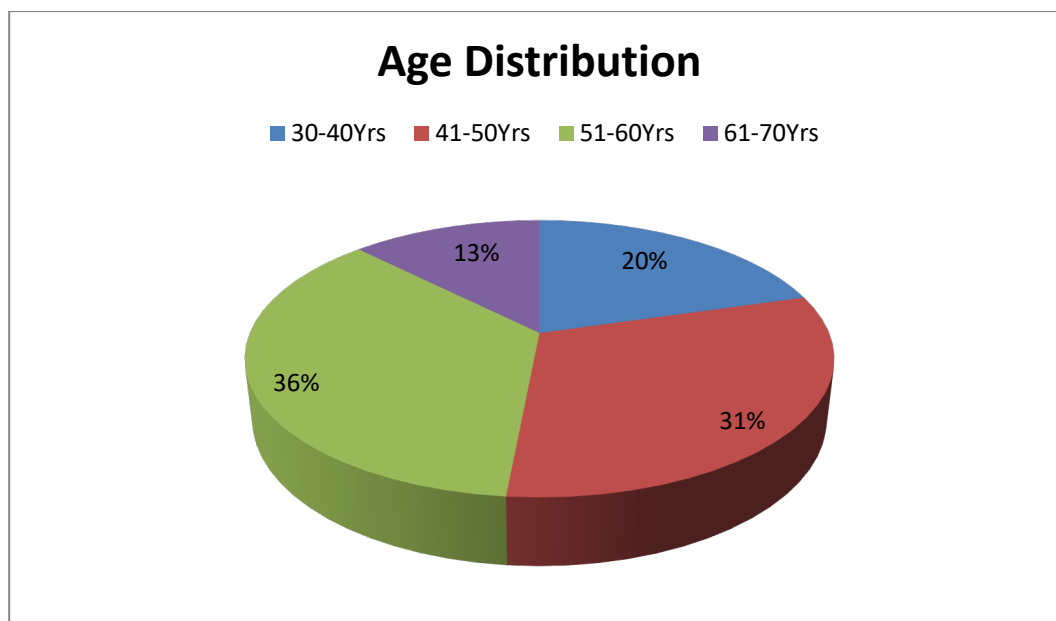
- Patients with mental illnesses, and who cannot answer the questionnaire.
- And participants who are not willing to participate will be excluded.

During study, participants are given a proforma which contains socio-demographic details, clinical variables related to diabetes, questionnaire related to medication and health-care factors, and MMAS 8-item questionnaire was given.

8-item MMAS is used to measure the degree of adherence to anti-diabetic medication, which consists of yes/no response alternatives. This MMAS is a medical measurement that also evaluates the degree of adherence to prescription medications using a scoring system (0 = no, 1 = yes). The great degree of adherence was indicated by the score of 8. Based on these scores, there are three categories of medicine adherence: high, medium, and low adherence, respectively. Microsoft Excel and SPSS (IBM SPSS21 version) for Windows were used to enter the data into a computer for analysis. Categorical data was presented in the form of frequency & percentages. To provide a summary of the results from this study sample, descriptive analysis was done.

Results

Out of 400 participants in this study, more than half were females (59%) & and 41% are males. The graph-1 presents the data about the age distribution of study participants used in this study.



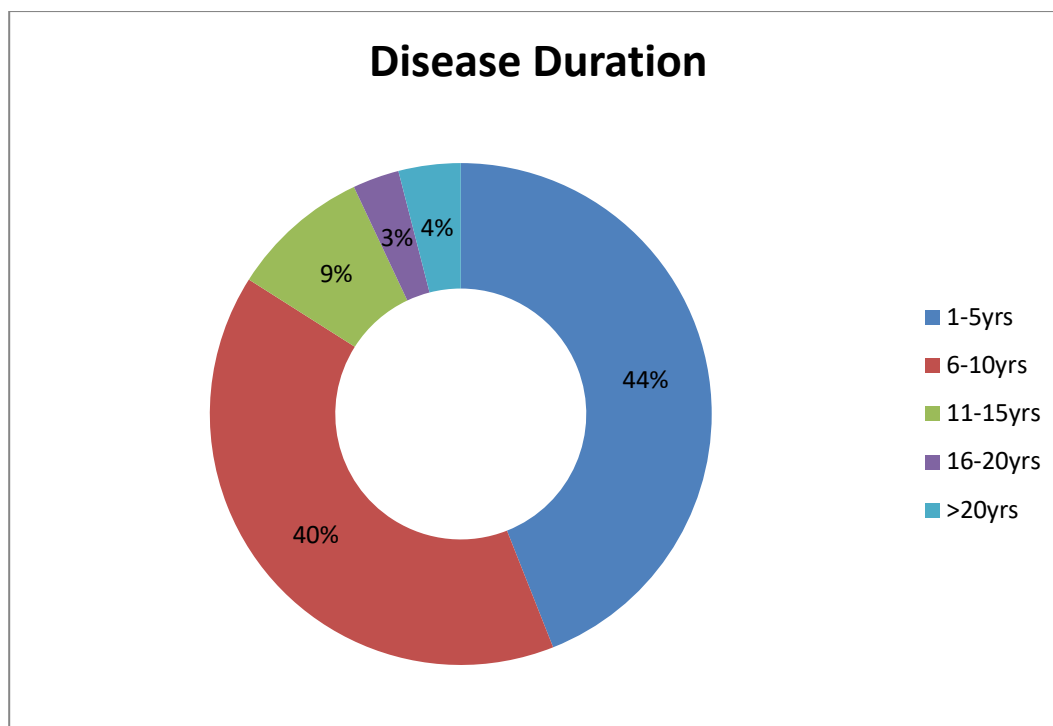
Graph 1: Age Distribution Graph

The participants' socio-demographic information, including age, sex, place of residence, education, marital status, and occupation, is displayed in table 1.

Table 1: Socio-demographic data of participants:

S. No.	Factors	Frequency (n)	Percentage (%)
1.	Age distribution		
	30-39	82	20.5
	40-49	124	31.0
	50-59	144	36.0
	60-70	50	12.5
2.	Gender		
	Male	164	41.0
	Female	236	59.0
3.	Place of residence		
	Rural	292	73.0
	Urban	108	27.0
4.	Education		
	Educated	240	60.0
	Uneducated	160	40.0
5.	Marital status		
	Married	301	75.2
	Unmarried	51	12.7
	Widow	48	12.0
6.	Occupation		
	Employed/Working	228	57.0
	Unemployed	172	43.0

The below graph-2 & table shows the data regarding the diabetic participants disease duration & current medication using by the subjects.



Graph 2: shows the disease duration of participants

According to their condition, the participants' use of various diabetes medications (different combination drugs) which are displayed in table 4 below.

Table 2: Different medication currently used for diabetes by the participants

S.no.	Current medication used	No. of patients (n)
1.	Metformin hydrochloride tables	108
2.	Metformin hydrochloride + Glimepiride	176
3.	Glipizide + Metformin	8
4.	1. Sitagliptin 2. Metformin	8
5.	Teneligliptin + Metformin ER	4
6.	Sitagliptin+ Metformin hydrochloride + Glimepiride	16
7.	1.Glimepiride,Voglibose & Metformin Hydrochloride (SR) 2.Teneligliptin	4
8.	1.Glimepiride& Metformin Hydrochloride (PR) 2.Vildagliptin 3.Dapagliflozin	4
9.	1.Metformin Hydrochloride & Glimepiride Tablets 2.Pregabalin& Methylcobalamine	8
10.	1.Metformin Hydrochloride (PR)&Glimepiride 2.Rapaglinde&Voglibose	12
11.	1.Rapaglinide&Voglibose 2.Metformin Hydrochloride &Glimepiride 3.Glimepiride, Metformin Hydrochloride &Voglibose Tab	4
12.	1.Repaglinide 2.Acarbose 3.Empagliflozin	4
13.	1.Voglibose,Glimepiride, Metformin hydrochloride 2.Metformin Hydrochloride (PR)&Glimepiride	4
14.	Dapagliflozin, Sitagliptin& Metformin Hydrochloride (ER)	20
15.	Glimepiride, Voglibose & Metformin Hydrochloride (ER)	20
	Total	400

Table 3 presents the data of medication factors that affect participant's drug compliance like 73% of participants used singles drug, 48% patients take drug once a day and 39% of them take twice a day,

and 89% of patients use single pharmacy for drug & 11% use multiple pharmacies. 13% Patients agreed that cost related factor affects the drug adherence.

Table 3: Medication factors

S. No.	Factors	Frequency (N)	Percentage (%)
1	Numbers of prescription drugs currently using		
	1	292	73.0
	2	80	20.0
	3	28	7.0
2	Frequency of doses		
	1	192	48.0
	2	156	39.0
	3	8	2.0
	4	44	11.0
3	Pharmacy pattern used		
	Single	356	89.0
	Multiple	44	11.0
4	Cost related adherence		
	Yes	52	13.0
	No	348	87.0
5	Knowledge on medication use		
	A little	292	73.0
	Enough	108	27.0
	No knowledge	0	0

Table 4 below lists some of the medication factors that influence diabetic patients' medicine use. According to the data, only 85% of patients attend routine follow-up appointments. Sixty-four percent

of patients stated that they typically get lab work done every three months, while 25% do so monthly and some frequently. According to 56% of patients, they take various alternative drugs.

Table 3: Health-care related factors

S. No.	Factors	Frequency (N)	Percentage (%)
1	Frequency of follow-ups		
	Regular	308	77.0
	Irregular	92	23.0
2	Frequency of clinical investigations		
	1 month	100	25.0
	3 months	256	64.0
	More	44	11.0
3	Use of different alternative drugs		
	Yes	224	56.0
	No	176	44.0

Various other concerns that impact treatment adherence include various comorbidities, such as the fact that 52% of them have one problem other than diabetes, 16% have two, and others have not

responded properly. Table 5 displays the findings of the MMAS scale on an 8-item questionnaire, indicating the proportion of patients who answered "yes" or "no" to each item.

Table-5: Morisky Medication –Taking Adherence Scale – MMAS (8-item)

S. No.	Questions	Yes (n)	No (n)
1.	Do you sometimes forget to take your diabetes pills?	68	332
2.	People sometimes miss taking their medications for reasons other than forgetting. Thinking over the past two weeks, were there any days when you did not take your [health concern] medicine?	52	348
3.	Have you ever cut back or stopped taking your medication without telling your doctor, because you felt worse when you took it?	36	364
4.	When you travel or leave home, do you sometimes forget to bring along your diabetes medication?	48	352
5.	Did you take your diabetes medicine yesterday?	368	24
6.	When you feel like your diabetes is under control, do you sometimes stop taking your medicine?	60	340
7.	Taking medication every day is a real inconvenience for some people. Do	64	336

	you ever feel hassled about sticking to your diabetes treatment plan?		
8.	How often do you have difficulty remembering to take all your medications?		
	Rarely ----0	284	
	Once in a while ----1	52	
	Sometimes -----2	49	
	Usually-----3	10	
	All the time -----4	5	

Discussion

Medication adherence is a critical component of successful long-term management of type 2 diabetes mellitus (T2DM). Because diabetes is a chronic and progressive disease requiring sustained pharmacological treatment along with lifestyle modification, failure to adhere to prescribed therapy can adversely affect glycaemic control and increase the risk of diabetes-related complications. The present cross-sectional study evaluated medication-taking behaviour among 400 patients with T2DM receiving oral hypoglycaemic agents and explored patient-, medication-, and healthcare-related factors that may influence adherence.

In the present study, females constituted a greater proportion of participants (59%) than males (41%). The largest proportion of participants belonged to the 50–59-year age group (36%), followed by those aged 40–49 years (31%). The predominance of middle-aged and older adults in the study population is consistent with the increasing occurrence of T2DM with advancing age. Most participants were from rural areas (73%), were educated (60%), married (75.2%), and employed or working (57%). These socio-demographic characteristics are important because educational status, social support, occupation, and accessibility to healthcare services may influence an individual's ability to understand and follow long-term treatment recommendations.

Medication adherence was assessed using the eight-item Morisky Medication Adherence Scale (MMAS-8), a widely used instrument for evaluating medication-taking behaviour. The item-wise findings of the present study demonstrate that several behavioural factors may contribute to non-adherence. Forgetting to take diabetes medication was reported by 68 participants (17%), indicating that unintentional non-adherence remains an important barrier. Similarly, 52 participants reported missing medication during the preceding two weeks for reasons other than forgetfulness. These findings are consistent with previous literature identifying forgetfulness and difficulties maintaining regular medication-taking behaviour as important contributors to poor adherence among patients with chronic diseases. Polonsky and Henry highlighted that medication adherence in T2DM is influenced by several behavioural and

psychological barriers, including forgetfulness, treatment burden, and patients' perceptions regarding the necessity of medication. [19]

Intentional medication non-adherence was also evident in some participants. Thirty-six participants reported reducing or discontinuing medication without informing their physician because they felt worse after taking it. Furthermore, 60 participants reported sometimes stopping their medication when they believed that their diabetes was under control. These findings are clinically important because T2DM may remain asymptomatic despite inadequate glycaemic control, potentially leading patients to underestimate the importance of continued therapy. Patient education should therefore emphasise that medications should be continued according to medical advice even when symptoms are absent or patients perceive their diabetes to be controlled.

Practical difficulties associated with maintaining regular treatment were also observed. Forty-eight participants reported forgetting to carry their medication while travelling or leaving home. In addition, 64 participants reported feeling hassled by the requirement to follow their diabetes treatment plan. These findings suggest that treatment burden and disruption of daily routines can contribute to medication non-adherence. Similar barriers have been described in previous studies of patients with T2DM, where the complexity and long duration of treatment were recognised as important determinants of poor adherence. Studies conducted in Tanzania, Botswana, Bangladesh, and other low- and middle-income settings have also reported substantial levels of poor adherence to anti-diabetic medications, emphasising that medication-taking behaviour remains a major challenge globally. [23,24]

Medication-related characteristics in the present study may also have influenced adherence. Most participants (73%) were receiving a single prescribed drug, while 20% and 7% were receiving two and three prescription drugs, respectively. Nearly half of the participants (48%) took their medications once daily, whereas 39% took medications twice daily. Simplified treatment regimens may facilitate better adherence by reducing the burden of medication administration. Previous literature has suggested that

polypharmacy and increasing regimen complexity can negatively affect medication adherence, particularly among patients with chronic diseases and comorbid conditions.

Cost-related factors affected medication adherence in 13% of participants. Although the majority did not report medication cost as a barrier, financial constraints remain clinically relevant because diabetes requires continuous and often lifelong treatment. Previous studies have identified medication affordability and out-of-pocket expenditure as important contributors to non-adherence, particularly in low- and middle-income countries. Therefore, healthcare providers should consider the affordability of prescribed treatment and, where appropriate, select cost-effective therapeutic options.

Knowledge regarding medication use was another relevant finding. In the present study, 73% of participants reported having only a little knowledge regarding medication use, whereas only 27% reported having sufficient knowledge. Inadequate understanding of the purpose, benefits, duration, and correct use of medications may contribute to inappropriate medication-taking behaviour. Patient counselling and repeated education during follow-up visits may therefore play an important role in improving adherence.

Healthcare-related factors also demonstrated potential barriers to optimal adherence. Regular follow-up visits were reported by 77% of participants, while 23% had irregular follow-up. Regular clinical follow-up provides an opportunity to reinforce treatment recommendations, identify adverse effects, address patient concerns, and assess barriers to medication adherence. Consequently, improving continuity of care and encouraging regular follow-up may contribute to better long-term treatment behaviour.

A notable finding of the present study was that 56% of participants reported using alternative medications. The use of alternative therapies may reflect cultural beliefs, patient preferences, dissatisfaction with conventional treatment, or attempts to improve disease control. However, unsupervised use of alternative treatments may potentially affect adherence to prescribed oral hypoglycaemic agents. Healthcare professionals should therefore routinely enquire about the use of complementary or alternative therapies and provide appropriate counselling regarding their use alongside prescribed treatment.

The findings of the present study support the multifactorial nature of medication adherence. Forgetfulness, medication-related concerns, perceived disease control, inconvenience, travel-related difficulties, limited knowledge, treatment

cost, irregular follow-up, and the use of alternative medications were identified as potential factors influencing medication-taking behaviour. This is consistent with previous studies demonstrating that adherence is determined by a complex interaction between patient-related, therapy-related, socioeconomic, and healthcare-system factors.

An important strength of the present study is the inclusion of a relatively large sample of 400 patients and the use of the MMAS-8 to systematically assess medication-taking behaviour. However, the findings should be interpreted considering certain limitations. The cross-sectional design does not establish causal relationships between the identified factors and medication adherence. Purposive sampling and recruitment from a single institution may limit the generalizability of the findings. In addition, medication adherence was assessed using self-reported responses, which may be affected by recall bias and social desirability bias. The results presented in the study are primarily item-wise MMAS-8 responses; therefore, the overall distribution of participants into high-, medium-, and low-adherence categories should be clearly reported in future analyses. Similarly, statistically significant associations between socio-demographic or clinical variables and adherence should be presented with appropriate chi-square values and p-values.

Overall, the present findings highlight the importance of identifying individual barriers to medication adherence during routine diabetes care. Patient-centred counselling, simplified medication schedules where clinically appropriate, improved patient education, regular follow-up, and discussion of financial and behavioural barriers may help improve adherence to oral hypoglycaemic therapy.

Conclusion

Medication adherence among patients with type 2 diabetes mellitus receiving oral hypoglycaemic agents is influenced by multiple behavioural, medication-related, socioeconomic, and healthcare-related factors. The present study identified forgetfulness, missed doses, medication discontinuation based on perceived disease control or adverse experiences, travel-related difficulties, treatment inconvenience, limited knowledge regarding medication use, medication cost, irregular follow-up, and the use of alternative medications as important potential barriers to optimal adherence.

The findings emphasise that improving medication adherence requires more than simply prescribing appropriate pharmacotherapy. Healthcare professionals should routinely assess medication-taking behaviour and identify individual barriers

through effective patient-provider communication. Regular patient education and counselling should focus on the importance of continuous treatment, the consequences of missed doses, appropriate management of adverse effects, and the need to seek medical advice before discontinuing medication. Simplification of treatment regimens, when clinically appropriate, improvement of access to affordable medicines, reinforcement of regular follow-up and patient-centred adherence interventions may contribute to improved medication-taking behaviour and better long-term diabetes management. Future multicentre studies using probability-based sampling and objective measures of adherence are recommended to further evaluate the determinants of medication adherence and develop effective interventions for patients with T2DM.

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