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Correlates of Medication Adherence Among Patients With Type 2 Diabetes Mellitus – A Study From Western Maharashtra

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ABSTRACT

Introduction: Non-adherence to medication remains a critical challenge in the management of Type 2 Diabetes Mellitus (T2DM), contributing to poor glycaemic control, increased complications and higher healthcare burdens. In India, where T2DM prevalence is rapidly rising, understanding the factors influencing adherence is essential for improving patient outcomes. **Aims and Objectives:** This study aimed to evaluate medication adherence and identify socio-demographic and clinical factors associated with adherence among Type 2 Diabetes Mellitus (T2DM) patients. **Materials and Methods:** An observational cross-sectional study was conducted among 155 T2DM patients visiting a tertiary care hospital in Karad, Maharashtra. Medication adherence was assessed using the 7-item Medication Compliance Questionnaire (MCQ), along with data on socio-demographic and clinical characteristics. Statistical analysis was performed using SPSS version 20. **Results:** Of the 155 participants, 92 (59.35%) were male and 63 (40.65%) were female. The overall mean MCQ score was 25.17 (SD 3.64), with 58% (n=90) being adherent to anti-diabetic treatment. The most common reason for non-adherence was forgetting to take medications, indicated by the lowest mean score (3.49 ± 0.77). Significant factors associated with adherence included education level, duration of T2DM, BMI, HbA1c levels and the presence of comorbidities. **Conclusion:** Study showed moderate adherence to T2DM treatment which poses a risk for complications. Improving patient education, addressing forgetfulness with reminders or support systems and managing comorbidities should be prioritized to enhance adherence and diabetes outcomes.

Keywords: *Medication adherence, Diabetes Mellitus, association, comorbidities*

1. INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) has emerged as a significant global challenge, particularly in low and middle-income countries, with India currently ranking second among nations with the highest number of cases [1,2] . Once considered a disease of the affluent and the elderly, diabetes now disproportionately affects lower socioeconomic groups and nearly half of those affected are aged 40 to 59[3]. Approximately 830 million people worldwide living with the condition—most in low- and middle-income countries and both the number of people with diabetes and the number of people with untreated diabetes have been steadily increasing over the past decades[4].

Timely treatment of T2DM is widely recognized for improving outcomes, with strict glycaemic control recommended to reduce the risk of both microvascular and macrovascular complications [5,6]. Without proper management, elevated blood sugar levels over time can lead to serious damage to the heart, blood vessels, eyes, kidneys, and nerves. Accordingly, non-adherence to prescribed diabetes medications is a prevalent challenge, often contributing to poor outcomes, decreased productivity, increased hospitalisation and mortality[7,8] . Studies have shown that more than 50% of patients with chronic diseases, including diabetes are non-adherent to long-term therapy[9,10].

The etiology of diabetes is complex and multifactorial, involving both modifiable factors, such as socioeconomic status, lifestyle choices, dietary habits and obesity as well as non-modifiable factors like genetic predisposition (including obesity-related genetic loci, genes involved in lipid metabolism), age and family history of the disease[11]. Due to its multifactorial nature, treatment often requires a combination of approaches, including dietary changes, regular exercise, medication and overall lifestyle changes. These lifelong medications with often multiple doses and lifestyle changes make treatment

adherence exhausting for the patients[12]. According to World Health Organization, medication adherence is the degree to which the person's behaviour corresponds with the agreed recommendations from a health care provider [13]. Adherence levels play a crucial role in predicting HbA1c, with higher adherence

associated with better glycaemic control, highlighting that much of the diabetes burden can be mitigated or postponed through improved treatment compliance. Since poor adherence to diabetes treatment can lead to severe complications, identifying factors contributing to adherence in patients with T2DM is essential for reducing both morbidity and mortality.

Given the gravity of the issue, this study was designed to evaluate the socio-demographic, lifestyle and clinical factors affecting medication adherence among patients with T2DM.

2. MATERIALS AND METHODS

An observational cross-sectional study was conducted to estimate Type 2 Diabetes Mellitus treatment adherence and explore factors affecting non-adherence. The minimum sample size was calculated using the formula: $n = \frac{z^2pq}{l^2}$; and taking p = 44% (proportion of patient adherent to treatment of type 2 DM)[14]; l= 8. Substituting these values, the estimated sample size was 154 and a total of 155 participants were included in the study, visiting the outpatient department of a tertiary care hospital, Karad, Maharashtra. Patients with Type 2 Diabetes Mellitus (T2DM) who had been diagnosed for at least one year, were aged between 30 to 75 years and provided informed consent were included in the study. This age group was chosen as it covers a wide range of diabetes patients, capturing variations in disease progression, treatment adherence and influencing factors across different adult ages.

The assessment of medication adherence was done using Medication Compliance Questionnaire (MCQ), scored with a 4-point Likert scale ranging from 4 (none of the time) to 1 (all the time). The MCQ consisted of seven questions designed to assess both intentional and unintentional non-adherence to medication instructions. The total scores were added for each patient and scores may range from 7 (minimum) to 28 (maximum). A score of 27 or above is classified as adherent, while a score of 26 and below is categorized as non-adherent[15]. Other data such as age, gender, education level, BMI, duration of T2DM, comorbidities, number of drugs taken, HbA1c level, family type and marital status were also collected. Data were fed into MS Excel and analyzed using software the Statistical Package for the Social Sciences (SPSS, IBM SPSS, Bengaluru, Karnataka, India, version 26). P value <0.05 is considered to be statistically significant. Informed and written consent was taken from the participants. Study was approved by institutional ethics committee. Respondent's confidentiality was maintained and participation was voluntary.

3. RESULTS

The findings of this study provide insights into the medication adherence patterns among Type 2 Diabetes Mellitus patients, highlighting key factors influencing non-adherence.

Table 1. Distribution of responses to MCQ items among participants (n=155)

Questions	Mean	Standard Deviation
How often do you forget to take your medicine?	3.49	0.77
How often do you decide not to take your medicine?	3.66	0.7
How often do you miss taking your medicine because you feel better?	3.55	0.79
How often do you decide to take less of your medicine?	3.59	0.78
How often do you stop taking your medicine because you feel sick due to effects of the medicine?	3.70	0.69
How often do you forget to bring along your medicine when you travel away from home?	3.57	0.74
How often do you not take your medicine because you run out of them?	3.61	0.75
Total Score	25.17	3.64

The mean scores for individual questions ranged from 3.49 to 3.70, indicating that most participants reported good compliance across all items. The lowest mean score was for the question "How often do you forget to take your medicine?"

(3.49 ± 0.77), suggesting this was the most frequent reason of non-adherence to diabetes treatment. The second most common reason for non-adherence was missing medication because participants felt better, as reflected

in a mean score of 3.55 (± 0.79). On the other hand, the highest mean score was for "How often do you stop taking your medicine because you feel sick due to the effects of the medicine?", implying that adverse effects were the least common reason for non-adherence. The total MCQ scores for participants had a mean of 25.17 (± 3.64), which indicates that while most

participants showed high adherence to their medication regimen, there was variability in

adherence levels **[Table 1].**

Total Score (28 points)	**Frequency**	**Percentage (%)**	**Status**
28 (100%)	41	26.45	Adherent
27 (>95%)	49	31.60	Adherent
23-26 (>80%-95%)	36	23.22	Nonadherent
18-22 (>60%-80%)	23	14.84	Nonadherent
<18(<60%)	6	3.87	Nonadherent

Table 2: Distribution of MCQ score range and adherence status. (n=155)

As mentioned earlier, a score of 27 or above is classified as adherent, with a maximum possible score of 28 while a score of 26 or less is categorized as non-adherent. In our study it was observed that more than half of the participants were adherent to medication, with more than one fourth of total participants achieving the perfect score of 28. Also, almost one third (31.6 %) of the participants of the study scored slightly below perfect (27), still categorized as adherent. However, a group of participants still struggled with non-adherence to treatment of T2DM, ranging from moderate to very poor levels of compliance. Overall, this distribution indicates that while adherence to antidiabetic medication was generally moderate among the participants, remaining participants exhibited varying levels of non- adherence **[Table 2].**

Table 3: Association of sociodemographic characteristics with adherence and non-adherence status (n=155)

Parameter	**GROUPS**	**ADHERENT (%)**	**NON-ADHERENT (%)**	**P-VALUE**
AGE	**30-45 years**	**19 (59.4)**	**13 (40.6)**	**.495**
	46-60 years	**39 (62.9)**	**23 (37.1)**	
	61-75 years	**32 (52.5)**	**29 (47.5)**	
GENDER	**Male**	**54 (58.7)**	**38 (41.3)**	**.847**
	Female	**36 (57.1)**	**27 (42.9)**	
Education level	**No formal education**	**10 (41.7)**	**14 (58.3)**	**.009***
	Primary education	**15 (40.5)**	**22 (59.5)**	
	Secondary education	**14 (60.9)**	**9 (39.1)**	
	Higher secondary education	**17 (65.4)**	**9 (34.6)**	
	Graduation and above	**34 (75.6)**	**11 (24.4)**	
Marital status	**Married**	**69 (54.8)**	**57 (45.2)**	**.158**
	Unmarried	**6 (85.7)**	**1 (14.3)**	

	Widow	**15 (68.2)**	**7 (31.8)**	
Family type	**Nuclear**	**35 (62.5)**	**21 (37.5)**	**.214**
	Joint	**29 (48.3)**	**31 (51.7)**	
	3 generation	**24 (68.6)**	**11 (31.4)**	
	Broken	**2 (50.0)**	**2 (50.0)**	

*P value <0.05 is considered to be statistically significant.

In the present study, out of total participants, most of the participant were aged between 46–60 years with 62.9% adherence rate, which was highest among the age groups. Gender-wise, adherence rates were almost similar, with males and females showing similar levels of adherence to their T2DM treatment. Education level was significantly associated with adherence, as individuals with no formal education were less likely to follow their prescribed

treatment compared to those with higher education, who showed greater consistency in adhering to their treatment plan.

Among marital status groups, unmarried participants showed the highest adherence to their T2DM treatment, followed by widowed individuals, while married participants had comparatively lower adherence. However, these differences were not statistically significant. Regarding family type, adherence was more common among those from three-generation families, followed by nuclear family members, while participants from joint families showed comparatively lower adherence. **[Table 3]**.

Table 4: Association of clinical characteristics with adherence and non-adherence status (n=155)

CHARACTERISTIC	GROUPS		ADHERENT (%)	NON-ADHERENT (%)	P-VALUE
Duration of T2DM	**<5 years**		**35 (66.0)**	**18 (34.0)**	**.021***
	5-10 years		**27 (54.0)**	**23 (46.0)**	
	10-15 years		**22 (68.8)**	**10 (31.2)**	
	>15 years		**6 (30.0)**	**14 (70.0)**	
T2DM treatment type	**Monotherapy**		**9 (69.2)**	**4 (30.8)**	**.250**
	Combination OHAs		**55 (53.4)**	**48 (46.6)**	
	OHAs and Insulin		**26 (66.7)**	**13 (33.3)**	
BMI	**18.5-24.9 (normal)**		**50 (71.4)**	**20 (28.6)**	**.005***
	25-29.9 (pre-obese)		**30 (53.6)**	**26 (46.4)**	
	30-34.9 (class I obese)		**8 (32.0)**	**17 (68.0)**	
	35-39.9 (class II obese)		**2 (50.0)**	**2 (50.0)**	
HbA1c levels	**6.5 or less (Good Control)**		**41 (82.0)**	**9 (18.0)**	**< .001***
	More than 6.5 (Poor Control)		**32 (43.8)**	**41 (56.2)**	
	Skipped/Not tested		**17 (53.1)**	**15 (46.9)**	
Comorbidities	**Hypertension**	**Yes**	**49 (49.5)**	**50 (50.5)**	**.004***
		No	**41 (73.2)**	**15 (26.8)**	
	Dyslipidaemia	**Yes**	**35 (46.1)**	**41 (53.9)**	**.003***
		No	**55 (69.6)**	**24 (30.4)**	
	Coronary Artery	**Yes**	**15 (38.5)**	**24 (61.5)**	**.004***

	Disease	**No**	**75 (64.7)**	**41 (35.3)**	
	Hypothyroidism	**Yes**	**20 (50.0)**	**20 (50.0)**	**.230**
		No	**70 (60.9)**	**45 (39.1)**	

*P value <0.05 is considered to be statistically significant.

In the present study, it was observed that participants who had diabetes for a shorter duration were more likely to adhere to their treatment, whereas those with a longer disease duration exhibited a decline in adherence. However, there was no significant association between adherence and different treatment types, including monotherapy, combination oral

hypoglycaemic agents and the use of both oral medications and insulin. For BMI, participants with a normal weight showed higher adherence to their treatment, whereas those classified as pre-obese and obese demonstrated lower adherence, indicating a significant association between BMI and adherence. HbA1c levels were strongly associated with adherence, as participants with well-controlled blood sugar levels were more likely to adhere to their treatment, whereas those with poor control exhibited lower adherence.

Participants with hypertension showed lower adherence to their T2DM treatment compared to those without hypertension. A similar trend was observed among individuals with dyslipidemia and coronary artery disease, where adherence was lower than those without these conditions. However, hypothyroidism did not show a significant correlation with adherence to T2DM treatment.

These findings highlight the need for targeted strategies addressing disease duration, weight management, glycemic control and comorbidity management to improve adherence **[Table 4]**.

4. DISCUSSION

Medication adherence remains a major challenge for T2DM patients and studies over the years have shown inconsistent results regarding adherence levels and it's associated factors. In the present study, overall medication adherence was assessed using the Medication Compliance Questionnaire (MCQ) and the overall mean adherence score was 25.17 ± 3.64. This reflects a general tendency towards adherence, although with variability among participants. Forgetfulness emerged as the most common reason for non-adherence (mean score 3.49 ± 0.77), followed by skipping medication due to feeling better (mean score 3.55 ± 0.79). Adverse drug effects were a less common reason for non-adherence, as shown by the highest mean score (3.70 ± 0.69) for stopping medication due to side effects. These findings align closely with a study conducted in Malaysia by Ahmad et al., where, mean adherence score was 25.60 with a standard deviation of 2.38 and similar to our study, the prime reason for non-adherence among participants was forgetfulness in taking medication[15]. Whereas, in a cross-sectional study conducted by Medi RK et al, financial constraints (55.84%) and forgetfulness (46.75%) were the main reasons for non-adherence[16]. These differences suggests that socio-economic factors might have played a deciding role in influencing adherence in that population, whereas, practical factors, such as forgetfulness and feeling better plays a larger role in non-adherence in the present study population. It also highlight the importance of interventions like reminders or digital tools to mitigate forgetfulness and improve adherence.

In this study, 58% of participants were found to be adherent to their prescribed medications, with 26.45% achieving a perfect adherence score of 28. The remaining 42% of participants in our study were non-adherent, with most scoring between 23 and 26. However, various studies evaluating adherence commonly agree that a threshold of 80% or higher is considered the benchmark for satisfactory adherence among patients[17,18]. Based on this criterion, the adherence levels of participants in our study fell short of the expected satisfactory threshold. Present study's moderate adherence level aligns closely with findings from the meta-analysis by Piragine et al., which reported a pooled adherence rate of 54%, and exceeds the 47.85% rate observed in the South Indian study by Medi RK et al [19,16]. A systematic review of 11 retrospective studies by Cramer found that adherence rates varied between 36% and 93%, highlighting that many T2DM patients, including those on oral hypoglycemic agents (OHAs) and insulin, were not consistently adhering to their treatment regimens[20].

Present study examined how various socio-demographic and clinical factors impacted medication adherence and non-adherence among study participants. It was seen that higher education levels significantly improved adherence to T2DM treatment, likely due to better health literacy and understanding of treatment regimens. Consistent with our findings, other studies demonstrate that higher education levels enhance medication adherence, while lower education levels are associated with lower adherence to T2DM treatment[21,22]. In a study conducted in the U.S. which included patients from all 50 states found that higher education levels, particularly completing graduate school, were associated with a greater likelihood of adherence[23]. Other socio-demographic factors such as age, gender, marital status, and family

type showed variations in adherence levels, but their association with treatment adherence was not statistically significant in this study.

It was seen in this study that the duration of diabetes significantly influenced medication adherence in this study. Participants with diabetes for less than five years had the

highest adherence rates (66%), while those with a disease duration of more than 15 years exhibited the lowest adherence (30%). This decline in adherence over time may be attributed to treatment fatigue and the increasing burden of managing chronic conditions. In contrast to our findings, some studies have reported that patients new to diabetes therapy are less likely to adhere to treatment [14,23]. These results highlight the need for continuous counselling and support for patients to maintain adherence and motivation over the years. This study also found no statistically significant association between treatment type and adherence status. However, patients on monotherapy showed higher adherence compared to those on combination therapy, including insulin. While not statistically significant, the complexity of managing multiple medications in combination therapy could contribute to lower adherence, which was also seen in the cross-sectional study conducted by Ahmed et al. in Malaysia[15]. Simplifying treatment regimens where feasible and providing clear instructions can potentially improve adherence in patients on combination therapy. It was seen in this study that participants with normal BMI were more likely to adhere to their medication, while adherence decreased as BMI increased, emphasizing the role of weight management in improving treatment adherence. Higher BMI is often associated with multiple comorbidities, making medication schedules more complex and increasing treatment fatigue. A similar finding was reported in a cross-sectional study conducted in Japan by Hashimoto et al., which demonstrated that a high BMI was positively associated with an increased risk of T2DM progression and lower adherence to treatment[24]. However, studies conducted by Ahmed et al. and Atair et al. reported no statistically significant association between BMI and adherence to T2DM treatment[14,15]. In the present study, glycemic control, measured by HbA1c levels, was strongly associated with adherence status. Participants with good glycemic control had significantly higher adherence rates compared to those with poor glycemic control. However, a study conducted among geriatric patients with Type 2 Diabetes Mellitus in Malaysia revealed contrasting findings, where neither HbA1c levels nor disease duration significantly influenced medication adherence. However, age and

education level were found to be strongly associated with adherence [25]. In this study population, the presence of comorbidities significantly impacted adherence status, consistent with the findings of Ahmed et al., who reported a significant association ($p=0.011$) between comorbidities and adherence[15]. It may be due to the increased complexity and fatigue associated with managing multiple medications and health conditions.

However, this study has certain limitations. Since the study was conducted in a single tertiary care hospital, the findings may not be fully generalizable to other settings, such as primary healthcare centers or rural populations. Future studies with objective adherence tracking, conducted in multiple settings with a larger sample, could provide deeper insights.

5. CONCLUSION

The study has shown moderate adherence to diabetes medications, emphasizing the need to implement targeted strategies to reduce non-adherence and mitigate the harmful effects of Type 2 Diabetes Mellitus (T2DM). Given the high prevalence of comorbidities, effective weight management and comorbidity control are crucial in improving health outcomes for diabetics. As most participants either had poor blood sugar control or skipped blood sugar testing, proper monitoring of blood sugar level and timely intervention are essential to enhance treatment effectiveness.

The study also found that education level was linked to better adherence which suggests that diabetes education should be prioritized to help patients understand the importance of medication and lifestyle changes. Counselling and awareness programs can encourage patients to take their treatment seriously and manage their condition better. Ensuring easy access to medications and using reminders or digital tools may improve adherence levels. Encouraging regular follow-ups and individualized treatment plans can help address barriers to adherence, particularly among patients with multiple health conditions.

Considering the long-term complications associated with poor diabetes management, these findings are valuable not only for researchers but also for healthcare providers, policymakers and patients. Future studies should focus on objective adherence tracking methods and a comprehensive approach that includes patients, caregivers and healthcare providers is essential for improving diabetes management.

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