Medication Adherence to Oral Hypoglycemic Drugs among Individuals with Type 2 Diabetes Mellitus – A Community Study

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Abstract

Context: Control of diabetes mellitus is a global challenge and nonadherence to diabetic medications is a public health concern. Factors related to patients, medications, and system can contribute to nonadherence. Aims: We aimed to determine self-reported adherence to oral hypoglycemics and to understand the determinants of medication adherence in a group of adult diabetics in South Kerala. Methods: A cross-sectional survey was conducted among 218 diabetic individuals. An eight-item questionnaire to assess the level of adherence and a structured interview schedule were administered to meet the objectives. Adherence was categorized as poor, moderate and high, based on k-means cluster analysis. Results: The proportion of good adherence was 60.09%. Higher age, male gender, nonalcoholic, higher family income, higher frequency of blood glucose monitoring, and controlled blood sugar level were independent predictors of good adherence. Conclusion: The proportion of individuals with poor medication adherence is low. Focus must be on determining factors influencing medication nonadherence.

Keywords: Determinants, diabetes mellitus, health expenditures, medication adherence

Introduction

Diabetes Mellitus (DM), a chronic medical condition, is imposing heavy financial burden at domiciliary, health system, and macroeconomic levels. The age-standardized prevalence of diabetes has nearly doubled from 4.7% to 8.5% in adult population from 1980 to 2014. India contributes to considerable share in the global economic burden, with prevalence of diabetes approximately 20% in urban and 10% in rural population. Nonadherence to treatment regimens in type 2 DM (T2DM) remains a substantial challenge resulting in wastage of resources, increasing the complications and mortality rates related to DM.

According to the World Health Organization, adherence is “the extent to which a person’s behaviour of taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a healthcare provider.” The prevalence of poor adherence was 74% among diabetics in rural Kerala. One can measure medication adherence in multiple ways either subjectively/subjectively or directly/indirectly. Nearly 10% of hospital and nursing home admissions are due to nonadherence to medications resulting in morbidity, provider and patient frustration, annoyance, and increased health-care costs adversely affecting the quality of life of patients and their families. Besides, low adherence results in re-emergence of drug resistance and reduced effectiveness of interventions, affecting evaluation process. Higher adherence rates have been reported among patients with acute (ADD - acute conditions like gastro intestinal disorders) than chronic conditions (pulmonary disease, diabetes, and sleep HIV, arthritis, cancers). Hence, the present study was proposed to determine the medication adherence to oral hypoglycemic agents and associated factors among T2DM individuals so that these factors could be considered in future care regimens.

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Methods
A cross-sectional community-based study was conducted among 218 T2DM individuals between November 2017 and September 2018 in an urban field practice area of a tertiary care institution in South Kerala. On the basis of prevalence of poor adherence in rural Kerala (75%),[5] the minimum sample size required was 203 at 99.9% confidence interval and with 10% allowable error. Any known T2DM case, aged 30 years and above, of both genders on treatment for at least past 1 year, irrespective of the type of health system followed, and consenting to participate, were included in the present study. Individuals with serious comorbid conditions warranting hospitalization were excluded. The recruitment was by multistage random sampling method. Five wards were chosen by lottery method in the initial stage after making a list of all wards which lay in close proximity with the urban field practice area. Following this, the list of individuals with T2DM was prepared from urban health training center register. During the second stage of sampling, every alternate person in the list was approached in each of these wards, until the sample size requirements were met. Case selection and recruitment was initiated after obtaining approval from the institutional ethics committee, and data were obtained by one-to-one personal interview. Written informed consent was obtained from all study participants prior to the interview. The research tools included predesigned structured questionnaire with details of socioeconomic variables, utilization of health-care services, laboratory investigations, and medications. Adherence to diabetic medications was assessed by an eight-item content validated questionnaire developed based on previous literature.[9,10] Seven questions had dichotomous answers and one had four options. Fasting blood sugar value (FBS) taken within the past 6 months and rough estimate of self-reported monthly expenditure for treating T2DM were also assessed. Respondents who were nonadherent to diabetic medications were asked open ended questions to determine the reasons for nonadherence to diabetic medications.

Data analysis
Data were entered in MS Excel 2010 and analyzed using a standard statistical software. Percentages and frequencies were calculated for the categorical variables, while means and standard deviations were estimated for continuous variables. Based on k-means cluster analysis, cutoff scores were 1–4 for poor adherence, 4.1–7.9 for moderate, and 8 for good adherence. Chi-square, Fisher’s, Kruskal–Wallis tests and ordinal regression were employed to prove association between independent variables and medication adherence. $P < 0.05$ was considered statistically significant.

Results
Sociodemographic profile
Among 218 T2DM individuals interviewed, more than half of the participants (131, 60.1%) were females. The mean age of the study group was 62.13 (12.22) years, predominantly belonging to 61–75 years’ age group (130, 59.6%) followed by 68 (31.2%) in 46–60 years’ age group. Three out of 218 (1.3%) were illiterate, 80 (36.7%) had completed high school-level education, and 70 (32.1%) had primary school level. A greater proportion were unemployed (99, 45.4%) or retired (52, 23.86%).

Adherence to diabetic medications
The median adherence score was observed to be 8 (interquartile range [IQR]: 2). The average adherence score per person was 6.78 (+1.85). More than half (131, 60.09%) were having good adherence to diabetic medications, and the proportion of moderate and poor adherence was 64 (29.36%) and 23 (10.55%), respectively.

More than three-fourth (191, 88.02%) considered taking medicines not a burden and did not adjust doses when feeling better. Majority agreed (207, 95.39%) that adherence prevents worsening of health status and 205 (94.7%) did not stop medications on trying alternate therapies.

Sociodemographic determinants
In this study, good medication adherence was observed in 61–70 years’ age group (18, 66.70%) when compared with 30–45 years’ age group (9.45%)(P = 0.001). Higher adherence was observed in high socioeconomic status group (54, 62.8%) than their counterparts (77, 58.3%) [P = 0.020; Table 1].

Health-related determinants
While majority of the nonalcoholics had good adherence to diabetic medications (123, 61.5%) than alcoholics (6, 35.3%) (P = 0.072), smoking history and family history of DM did not influence adherence. Medication adherence was higher among those who consulted a doctor more than six times a year (56, 67.5%; P = 0.015) and monitored blood glucose levels monthly (36, 70.6%; P = 0.035). It was observed that individuals with T2DM having comorbidities and complications were more adherent to medications (92, 64.3%) than those without (39, 52.0%; P = 0.004). The proportion of good adherence increased with the number of related comorbidities and complications (P = 0.020). Majority of the study participants relied on modern medicine. Three of the six (P = 0.019) individuals following other systems of medicine had poor adherence. Moreover, individuals with controlled blood sugar were more adherent (68, 71.6%) than those whose blood sugar was uncontrolled (62, 51.2%; P = 0.003). Medication adherence was not statistically significant with number and frequency of oral hypoglycemics, type of medical facility, and the distance to nearest health facility. Even though 119 (61.7%) individuals with no hospitalization history dominated in good adherence group, no statistically significant association was observed for those with hospitalization history where only 12 (48%) had good medication adherence [Table 2].

The participants who were adherent had higher monthly health-related expenditure than those who spent
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The present study included 218 individuals, predominantly older adults (61–75 years) and females (60.1%) among them. The median adherence score was observed as 8 (IQR 2) as against 6.5 in a study by Al-Qazaz et al.[11] The proportion of poor adherence was 10.4% comparable with Lin et al.[12] who reported it as 19.8%. Higher prevalence (50.2%, 65%, and 74%, respectively) of poor adherence was observed in various other studies.[5,9,13] The lower rate of nonadherence in this study might be because it was among urban residents, where the patients have more access to health-care facilities. 56.1% of individuals reported good adherence similar to Rozenfeld et al., who reported adherence of 65%.[14]

The finding that 33.64% forgot to take medicines was consistent with another study (55.12%). Higher age, utilizing tertiary level of health care, more visits to physician, monthly blood sugar level monitoring, presence of associated comorbidities or complications, following allopathic system of medicine, and controlled blood sugar level were associated with good medication adherence. These were consistent with a previous Nigerian study.[9] The current study revealed an increasing trend of good adherence with increasing age, supported by Huber and Reich.[13] Females were significantly less adherent than males in that study as was in our study.

### Table 1: Association between adherence and socioeconomic variables (n=218)

| Variables                  | Poor adherence, n (%) | Moderate adherence, n (%) | Good adherence, n (%) | P     |
|----------------------------|-----------------------|---------------------------|-----------------------|-------|
| Age group (years)          |                       |                           |                       |       |
| 30-45                      | 7 (35.0)              | 4 (20.0)                  | 9 (45.0)              | 0.001*|
| 46-60                      | 13 (19.1)             | 19 (27.9)                 | 36 (52.9)             |       |
| 61 and above               | 3 (2.3)               | 41 (31.5)                 | 86 (66.2)             |       |
| Gender                     |                       |                           |                       |       |
| Females                    | 18 (13.7)             | 42 (32.1)                 | 71 (54.2)             | 0.067 |
| Males                      | 6 (6.9)               | 21 (24.1)                 | 60 (69)               |       |
| Education                  |                       |                           |                       |       |
| Above high school          | 4 (5.9)               | 20 (29.4)                 | 44 (64.7)             | 0.405 |
| High school                | 12 (15.0)             | 25 (31.3)                 | 43 (53.8)             |       |
| Below high school          | 7 (10.0)              | 19 (27.1)                 | 44 (62.9)             |       |
| Occupation                 |                       |                           |                       |       |
| Working                    | 7 (10.4)              | 18 (26.9)                 | 42 (62.7)             | 0.387 |
| Un employed                | 14 (14.1)             | 29 (29.3)                 | 56 (56.6)             |       |
| Retired                    | 2 (63.5)              | 17 (32.7)                 | 33 (63.5)             |       |
| Income per month (Rs.)     |                       |                           |                       |       |
| <6213                      | 12 (17.6)             | 20 (29.4)                 | 36 (52.9)             | 0.119 |
| 6214-10,356                | 8 (12.5)              | 20 (31.3)                 | 36 (56.3)             |       |
| 10,357-20,714              | 2 (5.3)               | 9 (23.7)                  | 27 (71.1)             |       |
| 20,715-41,430              | 1 (2.1)               | 15 (31.3)                 | 32 (66.7)             |       |
| Marital status             |                       |                           |                       |       |
| Unmarried/widow            | 4 (7.3)               | 15 (27.3)                 | 36 (65.5)             | 0.546 |
| Married                    | 19 (11.7)             | 49 (30.1)                 | 95 (58.3)             |       |
| Socioeconomic status       |                       |                           |                       |       |
| Upper-lower middle         | 3 (3.5)               | 29 (33.7)                 | 54 (62.8)             | 0.020*|
| Upper lower-lower          | 20 (15.2)             | 35 (26.5)                 | 77 (58.3)             |       |

*Chi-square test P<0.05

less (P = 0.037; Kruskal–Wallis test). The median monthly expenditure was less (383.91 Indian Rupees (INR) with IQR of 13,338.83) among poor adherent groups, whereas it was 530.32 INR (IQR 16,063.95) among moderately adherent, and 733.37 INR (IQR 23,961.22) among those with good adherence.

All variables with P value up to 0.07 were considered for ordinal regression, and higher age, male gender, nonalcoholic, higher/lower monthly family income, monthly blood glucose monitoring, and controlled blood sugar level were independent predictors of good adherence after adjusting for other variables (pseudo $R^2 = 22.7\%$).

Multiple responses from 88 nonadherent individuals were characterized as patient related (forgetfulness - 57, negative attitude towards medication - 13, inappropriate knowledge - 2, depression - 2, ignoring self health - 2, asymptomatic - 12); medication related (side effects - 2, frequency of drugs - 3, multiple drugs - 11); social and economic (busy - 9, staying alone - 9, lack of family support - 7, cost of medicines - 11, transportation - 1) and health-related factors (poor accessibility to health services - 2, fear of hypoglycemia - 1). Patient-related factors (88, 100%) followed by social and economic factors (31, 35.23%), medication-related factors (16, 18.8%), and health-related factors (3, 3.4%) accounted for medication nonadherence.

### Discussion

The present study included 218 individuals, predominantly older adults (61–75 years) and females (60.1%) among them. The median adherence score was observed as 8 (IQR 2) as against 6.5 in a study by Al-Qazaz et al.[11] The proportion of poor adherence was 10.4% comparable with Lin et al.[12] who reported it as 19.8%. Higher prevalence (50.2%, 65%, and 74%, respectively) of poor adherence was observed in various other studies.[5,9,13] The lower rate of nonadherence in this study might be because it was among urban residents, where the patients have more access to health-care facilities. 56.1% of individuals reported good adherence similar to Rozenfeld et al., who reported adherence of 65%.[14] The finding that 33.64% forgot to take medicines was consistent with another study (55.12%). Higher age, utilizing tertiary level of health care, more visits to physician, monthly blood sugar level monitoring, presence of associated comorbidities or complications, following allopathic system of medicine, and controlled blood sugar level were associated with good medication adherence. These were consistent with a previous Nigerian study.[9] The current study revealed an increasing trend of good adherence with increasing age, supported by Huber and Reich.[13] Females were significantly less adherent than males in that study as was in our study,
although not significantly. This could be due to the fact that women are more prone to stress, and mental and emotional disorders like depression, factors not assessed in the current study.

Kassahun et al. demonstrated that education and monthly income were socioeconomic determinants of medication adherence.[16] However, a few studies have also supported that low income and low educational level do not have any impact on higher nonadherence rates, similar to the present study findings.[17] Cost of medications and forgetfulness were found to be the dominant factors for nonadherence in taking medicines in a few studies.[18,19] Previous research showed that individuals with poor adherence had to spend more compared to the adherent group.[20‑22] In our study, diabetics with poor adherence had lower overall costs. However, further analysis revealed that adherence itself did not have an independent relationship with cost, when adjusted for all other variables. According to Cheng et al., diabetic patients in the adherent group had higher drug expenses for oral hypoglycemic medications, a supportive evidence for present study.[23] Another supporting finding observed in many studies was that individuals who had comorbidities, especially three or more of those, were more adherent in taking medications.[21‑22] Park et al. found that there was a significant association with adherence and utilization of care such that individuals paying visits to tertiary hospitals (61.1%) were more adherent than those taking treatment in private hospitals (43.2%) supporting the current study.[24] The above findings might be justified that a greater number of complications and disability would have resulted in individuals strictly complying with the treatment, contributing to increased expenditure.

According to Chandran et al. (2015), good adherence helps in controlling the glycemic status.[21] Similar result was observed in this study where those who had controlled blood sugar levels were more adherent than those with uncontrolled FBS, supported by other studies as well.[14,17,25] Consistent with other studies, adherence was good among those who regularly visited the physician and monitored blood glucose levels, signifying the role of provider–patient relationship in improving medication adherence.[26,27]

Majority of participants reported forgetfulness (64.77%) as the important cause of medication nonadherence. Regarding missed dose, 66.82% in the present study never missed taking medicines, 42 (19.4%) forgot medicines at least once or twice monthly, and only a small proportion (9, 4.15%) forgot taking medications more frequently. Missing medication dose was observed to be much lesser than reported by Wabe et al., where

| Table 2: Association between adherence and medical variables (n=218) |
|---------------------------------------------------------------|
| **Variables** | **Poor adherence, n (%)** | **Moderate adherence, n (%)** | **Good adherence, n (%)** | **P** |
|----------------|---------------------------|------------------------------|---------------------------|-------|
| Duration of T2DM (years) |                           |                              |                           |       |
| Up to 10         | 18 (14.2)                 | 38 (29.9)                    | 71 (55.9)                 | 0.252 |
| 11-20            | 3 (4.2)                   | 20 (28.2)                    | 48 (67.6)                 |       |
| 20 and above     | 2 (10.0)                  | 6 (30.0)                     | 12 (60.0)                 |       |
| Number of outpatient visits in a year |                   |                              |                           |       |
| 0-3              | 19 (17.9)                 | 30 (28.3)                    | 57 (53.8)                 | 0.015*|
| 4-5              | 1 (3.4)                   | 10 (34.5)                    | 18 (62.1)                 |       |
| 6 and above      | 3 (3.6)                   | 24 (28.9)                    | 56 (67.5)                 |       |
| Yearly frequency of venous glucose monitoring |                   |                              |                           |       |
| 0-3              | 11 (21.2)                 | 16 (30.8)                    | 25 (48.1)                 | 0.035*|
| 4-5              | 9 (7.8)                   | 36 (31.3)                    | 70 (60.9)                 |       |
| 6 and above      | 3 (5.9)                   | 12 (23.5)                    | 36 (70.6)                 |       |
| Associated conditions |                   |                              |                           |       |
| Present          | 8 (5.6)                   | 43 (30.1)                    | 92 (64.3)                 | 0.004*|
| Absent           | 15 (20.0)                 | 21 (28.0)                    | 39 (52.0)                 |       |
| Number of comorbidities/complications |                           |                              |                           |       |
| 0                | 16 (19.3)                 | 24 (28.9)                    | 43 (51.8)                 | 0.020*|
| 1                | 5 (5.6)                   | 25 (27.8)                    | 60 (66.7)                 |       |
| 2 or more        | 2 (4.4)                   | 15 (33.3)                    | 28 (62.2)                 |       |
| <5 km            | 20 (11.5)                 | 49 (28.2)                    | 105 (60.3)                |       |
| >5 km            | 3 (6.8)                   | 15 (34.1)                    | 26 (59.1)                 |       |
| Health system** |                           |                              |                           |       |
| Modern medicine  | 20 (9.4)                  | 63 (29.7)                    | 129 (60.8)                | 0.019**|
| Ayurveda         | 3 (50.0)                  | 1 (16.67)                    | 2 (33.33)                 |       |
| Fasting blood sugar level |                   |                              |                           |       |
| Uncontrolled     | 19 (15.7)                 | 40 (33.1)                    | 62 (51.2)                 | 0.003*|
| Controlled       | 4 (4.2)                   | 23 (24.2)                    | 68 (71.6)                 |       |

*Chi square test P<0.05. **Fisher’s exact test P<0.05. T2DM: Type 2 diabetes mellitus
51.3% never missed taking medication and 36.6% missed taking medicines either daily or sometimes. Forgetfulness, busy schedule, side effects of drugs, being asymptomatic, and self-perceived negative attitude to prescribed antidiabetic drugs were the reasons for nonadherence that concurred with the current study findings.\cite{28}

**Strengths and limitations**

Many studies on medication adherence among diabetic individuals have been conducted in hospital settings whereas the current study was purely a community-based study. Medication adherence was measured using self-reported questionnaire, which is less valid than alternative methods such as pill counting and medication possession ratio.

**Conclusion and Recommendations**

The study found that 60.09% of individuals had good, 29.36% moderate, and 10.55% poor adherence to diabetic medications. Physicians while prescribing medications must pay attention on younger age individuals, females, alcoholics, low-income group, uncontrolled blood glucose level, and those on irregular follow-up. Adoption of a simple regimen at affordable costs through the health systems can improve adherence as well as cost. Treatment support groups may be established among diabetic individuals, and measures such as smart phone applications for medication reminders to combat forgetfulness can be developed. Further assessment with larger sample is required to explore more on these aspects in future.

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**Conflicts of interest**

There are no conflicts of interest.

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