Section: Community Medicine

Original Research Article

DIABETES KNOWLEDGE, SELF-MANAGEMENT PRACTICES AND TREATMENT ADHERENCE IN RELATION TO GLYCAEMIC CONTROL AMONG ADULTS WITH TYPE 2 DIABETES MELLITUS IN AN URBAN SLUM

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ABSTRACT

Background: Diabetes self-management and medication adherence are central to long-term glycemic care, but may be difficult to sustain in communities facing socioeconomic and health-service constraints. Objective: To assess diabetes knowledge, self-management practices and medication adherence and examine their relationship with glycemic control among adults with type 2 diabetes mellitus in an urban slum.

Materials and Methods: A descriptive cross-sectional study was conducted among 200 adults with type 2 diabetes mellitus attending an Urban Health Training Centre in Maharashtra. Diabetes knowledge was assessed using the ICMR-INDIAB knowledge questionnaire, self-management using the Diabetes Self-Management Questionnaire (DSMQ), and medication adherence using an eight-item questionnaire. Glycaemic status was assessed using recorded HbA1c. Associations were examined using Pearson chi-square statistics with conditional Monte Carlo testing for sparse tables, and Kruskal–Wallis comparisons. Estimates were presented with 95% confidence intervals.

Results: Moderate glycaemic control was present in 149/200 participants (74.5%; 95% CI 68.0–80.0), good control in 21 (10.5%), and poor control in 30 (15.0%). The mean DSMQ sum score was 5.75 (SD 1.32; 95% CI 5.57–5.93). Low medication adherence was reported by 99 participants (49.5%; 95% CI 42.6–56.4), medium adherence by 86 (43.0%), and high adherence by 15 (7.5%). Knowledge category was associated with HbA1c category (χ^2=25.40; Monte Carlo p=0.0022). Healthcare-use scores differed across glycaemic groups (p=0.042); other DSMQ domains and the sum score did not. Medication adherence was associated with HbA1c category (χ^2=140.31; Monte Carlo p<0.001).

Conclusion: Low medication adherence and gaps in diabetes knowledge were common. Knowledge and adherence categories were associated with glycaemic control, whereas most self-management domains were not. Community diabetes services should integrate education and self-management support with assessment of medication barriers and continuity of medicine supply.

Keywords: Type 2 diabetes mellitus; diabetes self-management; medication adherence; diabetes knowledge.

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder that requires sustained treatment and daily self-management to reduce symptoms and prevent vascular complications. Its burden continues to rise: the International Diabetes Federation estimated that 537 million adults were living with

diabetes in 2021, with the largest numbers in low- and middle-income countries. India has a substantial and geographically varied burden, shaped by urbanisation, changing diets, physical inactivity and social determinants of health. These pressures are especially relevant in urban slums, where residents may face constrained household resources, limited access to continuity of care, and difficulty obtaining medicines or reliable health information. Glycaemic status is commonly assessed using glycated haemoglobin (HbA1c), which reflects average glycaemia over approximately two to three months and supports treatment review.[1,2]

Living with T2DM also requires patients to understand the disease, recognise the importance of long-term treatment, and practise glucose monitoring, dietary regulation, physical activity and timely use of health services. Indian studies have documented gaps in diabetes awareness and self-care, with variation by education, socioeconomic circumstances and access to counselling. Community-based work in urban slums has similarly described uneven performance across diet, exercise, glucose monitoring and medicine use. Knowledge alone may not produce better glycaemic control when cost, medicine availability, adverse effects, work demands or the structure of health services interfere with self-care. In an urban-slum study in Navi Mumbai, financial constraints and difficulty remembering treatment were prominent barriers to continuity.[3-6]

Medication adherence is a key part of diabetes care, yet estimates vary according to population and measurement instrument. Indian studies have reported both low adherence and substantial barriers to treatment, while recent multicentre work has found that greater diabetes knowledge may coexist with more regular medication use.[7-9] Self-management practices and adherence should therefore be examined alongside measured glycaemic outcomes, rather than treated as interchangeable behaviours. The present study used data from adults with T2DM attending an Urban Health Training Centre in an urban-slum field-practice area in Maharashtra. It assessed diabetes knowledge, self-management practices and medication adherence and examined their cross-sectional relationship with HbA1c categories. This community-focused evidence can help identify practical gaps for counselling and primary-care follow-up; because the design was cross-sectional, observed associations cannot establish temporal or causal effects.

Aim: To assess diabetes knowledge, self-management practices and treatment adherence and examine their relationship with glycaemic control among adults with type 2 diabetes mellitus in an urban slum.

Objectives:

- To assess diabetes-related knowledge and self-management practices among adults with type 2 diabetes mellitus.
- To determine the level of medication adherence among the study participants.
- To examine the association of diabetes knowledge, self-management practices and medication adherence with glycaemic control.

MATERIALS AND METHODS

Source of data: Data were obtained from adults with type 2 diabetes mellitus who attended the outpatient department of the Urban Health Training Centre serving the urban-slum field-practice area of H.B.T. Medical College and Dr. R. N. Cooper Hospital, Mumbai, Maharashtra. HbA1c and other relevant investigation values were abstracted from the treating physician's outpatient records; no additional blood sample was collected specifically for this study.

Study design: A descriptive cross-sectional study was conducted.

Study location: The study was undertaken at an Urban Health Training Centre in Maharashtra, within the urban-slum field-practice area linked to H.B.T. Medical College and Dr. R. N. Cooper Hospital, Mumbai.

Study duration: The study was conducted during June 2022 to July 2024. Participant data were collected over six months, from May to October 2023.

Sample size: The sample size was calculated using the single-proportion formula, $n = Z^2p(1-p)/d^2$. With a 95% confidence level ($Z = 1.96$), expected urban diabetes prevalence $p = 0.153$, and absolute precision $d = 0.05$, $n = (1.96)^2 \times 0.153 \times 0.847/(0.05)^2 = 199.1$, rounded up to 200. The final analytic sample comprised 200 adults with diagnosed type 2 diabetes mellitus.

Inclusion criteria

Adults aged 30 years or older of either sex, residing in the Urban Health Training Centre field-practice area slum for at least one year, with newly or previously diagnosed type 2 diabetes mellitus, and willing to participate were included.

Exclusion criteria

People with gestational diabetes or another form of diabetes, serious uncontrolled comorbidity such as coronary heart disease or chronic kidney disease, critical illness with deranged vital signs, or mental retardation, psychotic disorder or cognitive decline were excluded.

Procedure and methodology: After the study purpose was explained and written informed consent was obtained, trained study personnel completed a case-record form and administered the diabetes knowledge questionnaire used in the ICMR India Diabetes (ICMR-INDIAB) study [10], the Diabetes Self-Management Questionnaire (DSMQ) [11], and the eight-item questionnaire for medication adherence. Knowledge was expressed as a composite percentage score and grouped as 0–24%, 25–49%, 50–74%, 75–99% and 100%. DSMQ subscales covered glucose management, dietary control,

physical activity and healthcare use. Medication adherence was classified as low, medium or high using the questionnaire scoring applied in the study.

Sample processing: No study-specific bio-specimen processing was performed. Fasting and postprandial blood glucose and HbA1c results were transcribed from clinical records. Glycaemic control was categorised as good (HbA1c <6.5%), moderate (6.5–7.9%) or poor (>8.0%).

Data collection: Socio-demographic and clinical history, questionnaire responses and relevant laboratory values were recorded for 200 participants. Questionnaire data were collected through interviewer administration. Written informed consent and Institutional Ethics Committee (IEC) approval were obtained.

Statistical analysis: Data were entered in Microsoft Excel 2019 and analysed using IBM SPSS version 21.0. Categorical variables were summarised as frequencies and percentages, and continuous variables as means and standard deviations. Wilson 95% confidence intervals were calculated for proportions, and t-based 95% confidence intervals for means. Pearson chi-square tests assessed categorical associations. For the knowledge-by-HbA1c and adherence-by-HbA1c tables, sparse expected counts were addressed by conditional Monte Carlo tests using the Pearson chi-square statistic, with fixed row and column margins and 1,000,000 simulated tables per comparison (SciPy 1.17.0; random seed 20261015). Monte Carlo p-values were calculated as (b+1)/(B+1), where b was the number of simulated statistics at least as large as the observed statistic and B was the number of simulations. Kruskal–Wallis p-values for DSMQ comparisons were retained from the study analysis; H statistics were unavailable and were not reconstructed. Analyses were unadjusted, and $p<0.05$ was considered statistically significant.

RESULTS

A total of 200 adults with type 2 diabetes mellitus were included in the study. Glycaemic control, knowledge and self-management scores, medication adherence, and their associations are presented in [Table 1-4].

Table 1: Glycaemic control among study participants (N = 200)

Glycaemic category	No. (%)	95% CI (%)
Good control (HbA1c <6.5%)	21 (10.5)	7.0-15.5
Moderate control (HbA1c 6.5-7.9%)	149 (74.5)	68.0-80.0
Poor control (HbA1c >8%)	30 (15.0)	10.7-20.6
HbA1c, mean (SD), %	7.4 (1.3)	7.22-7.58

It was seen from [Table 1] that the moderate glycaemic control was the most frequent category, accounting for 149 participants (74.5%; 95% CI 68.0–80.0). Good control was observed in 21 participants (10.5%), while 30 (15.0%) had poor control. Mean HbA1c was 7.4% (SD 1.3; 95% CI 7.22–7.58).

Table 2: Diabetes knowledge and self-management practice scores (N = 200)

Measure	Result	95% CI	Test statistic / p-value
Knowledge categories by Sex			
Knowledge score 0-24%	33 (16.5%)	12.0-22.3	$\chi^2 = 4.02$; df = 4; p = 0.404
Knowledge score 25-49%	45 (22.5%)	17.3-28.8	
Knowledge score 50-74%	63 (31.5%)	25.5-38.2	
Knowledge score 75-99%	54 (27.0%)	21.3-33.5	
Knowledge score 100%	05 (2.5%)	1.1-5.7	
DSMQ glucose management, mean (SD)	6.19 (1.53)	5.98-6.40	
DSMQ dietary control, mean (SD)	5.37 (1.39)	5.18-5.56	
DSMQ physical activity, mean (SD)	5.52 (2.13)	5.22-5.82	
DSMQ healthcare use, mean (SD)	5.56 (1.74)	5.32-5.80	
DSMQ sum score, mean (SD)	5.75 (1.32)	5.57-5.93	
DSMQ sum score by Sex	Male 5.75 (1.33); female 5.75 (1.31)	Mean difference 0.00 (approx. −0.36 to 0.36)	Welch t = 0.00; p = 1.000

As [Table 2] shows that the largest knowledge group scored 50-74% (63; 31.5%), followed by 75-99% (54; 27.0%). Only five participants (2.5%) achieved a score of 100%. Knowledge-category distribution did not differ significantly by sex (χ^2=4.02, df=4, p=0.404). The mean DSMQ sum score was 5.75 (SD 1.32; 95% CI 5.57-5.93), with domain means ranging from 5.37 for dietary control to 6.19 for glucose management. The aggregate mean sum score was the same for men and women.

Table 3: Medication adherence categories (N = 200)

Adherence category	Overall No. (%)	95% CI (%)	Male No. (%)	Female No. (%)
Low	99 (49.5)	42.6-56.4	81 (63.8)	18 (24.7)
Medium	86 (43.0)	36.3-49.9	38 (29.9)	48 (65.8)
High	15 (7.5)	4.6-12.0	08 (6.3)	07 (9.6)
Association with sex			$\chi^2 = 28.84$; df = 2; p < 0.001	

As [Table 3] shows that low medication adherence was reported by 99 participants (49.5%; 95% CI 42.6-56.4), medium adherence by 86 (43.0%), and high adherence by 15 (7.5%). The distribution differed by sex (χ^2=28.84, df=2, p<0.001): low adherence was more frequent among men, while medium adherence was more frequent among women. In this study, common reasons for low adherence were non-availability of medicines at government facilities (35/99; 35.4%), high cost (26/99; 26.3%), adverse effects (23/99; 23.2%), and stopping medication after symptoms subsided (15/99; 15.2%).

Table 4: Relationship of knowledge, self-management and medication adherence with glycaemic control

Measure / category	Good No. (%)	Moderate No. (%)	Poor No. (%)	95% CI for poor-control proportion / score mean	Test statistic	p-value
Knowledge 0-24%	1 (3.0)	22 (66.7)	10 (30.3)	17.4-47.3%	χ^2=25.40; df=8	0.0022*
Knowledge 25-49%	2 (4.4)	32 (71.1)	11 (24.4)	14.2-38.5%		
Knowledge 50-74%	6 (9.5)	50 (79.4)	7 (11.1)	5.5-21.2%		
Knowledge 75-99%	10 (18.5)	42 (77.8)	2 (3.7)	1.0-12.6%		
Knowledge 100%	2 (40.0)	3 (60.0)	0 (0.0)	0.0-43.4%		
DSMQ glucose management mean (SD)	6.22 (1.60)	6.19 (1.49)	6.13 (1.72)	Good 5.49-6.95; Moderate 5.95-6.43; Poor 5.49-6.77	H=0.55; df=2	0.760
DSMQ dietary control mean (SD)	5.52 (1.25)	5.31 (1.43)	5.58 (1.26)	Good 4.95-6.09; Moderate 5.08-5.54; Poor 5.11-6.05	H=2.16; df=2	0.340
DSMQ physical activity mean (SD)	5.72 (1.73)	5.39 (2.23)	6.04 (1.82)	Good 4.93-6.51; Moderate 5.03-5.75; Poor 5.36-6.72	H=3.67; df=2	0.160
DSMQ healthcare use mean (SD)	5.61 (1.91)	5.42 (1.71)	6.22 (1.64)	Good 4.74-6.48; Moderate 5.14-5.70; Poor 5.61-6.83	H=6.34; df=8	0.042
DSMQ sum score mean (SD)	5.86 (1.20)	5.65 (1.35)	6.17 (1.21)	Good 5.31-6.41; Moderate 5.43-5.87; Poor 5.72-6.62	H=5.59; df=2	0.061
Low adherence	8 (8.1)	61 (61.6)	30 (30.3)	22.1-39.9%	χ^2=140.31; df=4	<0.001*
Medium adherence	0 (0.0)	86 (100.0)	0 (0.0)	0.0-4.3%		
High adherence	13 (86.7)	2 (13.3)	0 (0.0)	0.0-20.4%		

(Values are n (%) or mean (SD). Percentages are within each knowledge or adherence category. *Conditional Monte Carlo p-value based on the Pearson chi-square statistic. †Kruskal–Wallis p-values are reported; H statistics were available. Confidence intervals for DSMQ scores are t-based intervals for group means.)

It was seen from [Table 4] that the knowledge category was associated with glycaemic-control category (Pearson χ^2=25.40; conditional Monte Carlo p=0.0022). The proportion with poor control declined from 30.3% in the 0–24% knowledge group to 0.0% in the 100% group, although the latter contained only five participants. Among DSMQ comparisons, healthcare-use score differed across glycaemic groups (p=0.042); glucose management, dietary control, physical activity and the sum score did not differ significantly. Medication adherence category was associated with glycaemic-control category (Pearson χ^2=140.31; conditional Monte Carlo p<0.001). Poor control occurred in 30/99 participants with low adherence and in none of the participants with medium or high adherence. All 86 participants with medium adherence were classified as having moderate glycaemic control.

DISCUSSION

In this sample, nearly three quarters of participants were in the moderate HbA1c category, while 15.0% were classified as poorly controlled and 10.5% as having good control. The ADA identifies HbA1c as a primary measure for assessing glycaemic status, while emphasising individualised targets and regular reassessment.[2] The observed distribution is consistent with the continuing challenge of achieving glycaemic targets in routine care. In a large urban-slum cohort in Central India, poor adherence and social vulnerability were associated with an unfavourable glycaemic trajectory.[12] The present study adds a focused description of knowledge, self-management and adherence in an urban-slum clinic population, but its single-centre cross-sectional design cannot establish whether these factors preceded the measured HbA1c.

Knowledge and self-management practices: About 39.0% of participants scored below 50% on the diabetes knowledge composite, while 29.5% scored at least 75%. Knowledge categories were not significantly associated with sex, but knowledge was associated with glycaemic-control category. This pattern supports the importance of diabetes education while also showing that knowledge may be

constrained by access to care and opportunities to act on advice. Kishore et al. described gaps in awareness and treatment-seeking among people with T2DM in Delhi,[3] and Kakade et al. reported variable knowledge and self-care in a tertiary-care population.[4] A recent multicentre Indian study found that higher knowledge groups more often reported medication adherence and glucose-monitoring behaviours.[9] Differences in instruments, populations and sampling make direct percentage comparisons inappropriate, but the direction of evidence supports repeated, understandable, locally adapted counselling.

The DSMQ sum score was 5.75 (SD 1.32). Dietary control had the lowest domain mean (5.37), while glucose management had the highest (6.19). Chandrika et al. found that in an urban slum in Hyderabad, good diet and exercise behaviours were less common than monitoring and medication behaviours.[6] Shivananda et al. likewise documented gaps in self-care practices in rural India.[13] The present study found no statistically significant association between most DSMQ domains and HbA1c; the healthcare-use domain alone differed across HbA1c groups. Higher healthcare-use scores among participants with poor control may reflect increased service use in response to complications or poor glycaemia, rather than a harmful effect of seeking care. Because this study was cross-sectional, the direction of this relationship cannot be determined.

Medication adherence: Low adherence affected 49.5% of participants, and only 7.5% were classified as having high adherence. This profile is consistent with the challenges described in community settings, although rates vary across instruments and populations. Kotian et al. reported financial constraints and difficulty remembering treatment among people with diabetes in urban slums of Navi Mumbai.[5] Shamkuwar et al. and Govindani et al. also documented substantial adherence challenges in Indian clinical populations.[7,8] In the present study, medicine non-availability, cost, adverse effects and stopping medication after symptoms improved were the principal reasons reported for low adherence. These barriers suggest that medication counselling should be paired with continuity of supply, clear instructions about asymptomatic disease, and follow-up that addresses adverse effects and affordability. Adherence category was associated with HbA1c category in the study cross-tabulation. A Central India longitudinal study found good drug adherence to be associated with a more favourable glycaemic trajectory,[12] providing complementary evidence with a stronger temporal design. The conditional Monte Carlo analysis supported an overall association between adherence and glycaemic-control categories. However, all participants with medium adherence were classified as having moderate control, and no participant with medium or high adherence had poor control. This concentration of observations limits subgroup interpretation; the association was unadjusted and does not establish a causal effect of adherence.

Limitations

- This cross-sectional study measured knowledge, practices, adherence and glycaemic status at one point in time and cannot establish temporality or causality.
- Participants were recruited by convenience sampling from one Urban Health Training Centre; findings may not represent all adults with diabetes in the slum or other settings.
- Knowledge, self-management and adherence were assessed using self-reported instruments and may be affected by recall and social-desirability bias.
- Associations were unadjusted; potential confounding by age, diabetes duration, treatment regimen and socioeconomic circumstances was not assessed.
- Conditional Monte Carlo testing addressed sparse expected counts for the overall association tests but did not remove potential classification errors or confounding.
- Laboratory values were abstracted from routine clinical records rather than measured in a study laboratory, and HbA1c assay details were unavailable.

CONCLUSION

Among 200 adults with type 2 diabetes mellitus attending an urban-slum health centre, most had moderate glycaemic control, and 15.0% had poor control. Knowledge scores varied, and low medication adherence was common. Knowledge and adherence categories were associated with HbA1c category, whereas most DSMQ domains and the sum score were not; healthcare-use score differed across glycaemic groups. These unadjusted cross-sectional findings support integrating diabetes education, self-management support, routine adherence review and reliable access to affordable medicines into community diabetes care.

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