Association of Dietary Pattern, Physical Activity and Medication Adherence With Glycemic Control Among Patients With Type 2 Diabetes Mellitus Attending an Urban Health & Training Centre in South India

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ABSTRACT

Background

Type 2 diabetes mellitus (T2DM) poses a major public health challenge in urban India, where rapid urbanisation, sedentary behaviour, and changing dietary habits contribute to poor glycemic outcomes. National evidence indicates that more than 60% of individuals with diabetes fail to achieve optimal glycemic targets. This study assessed the association of dietary pattern, physical activity, and medication adherence with glycemic control among patients attending an Urban Health & Training Centre (UHTC) in Tamil Nadu.

Methods

A cross-sectional analytical study was conducted at the UHTC between January and December 2024 among 402 adults with T2DM. Systematic random sampling (every third patient) was used. Dietary pattern was assessed using the ICMR–NIN Food Frequency Questionnaire, physical activity using the WHO GPAQ, and medication adherence using the MMAS-8 scale. Glycemic control was categorised as good (HbA1c <7%) or poor (≥7%). Multivariate logistic regression identified independent predictors of poor glycemic control.

Results

Poor glycemic control was observed in 66.4% of participants. Poor diet quality, low physical activity, and low medication adherence were significantly associated with poor glycemic control ($p < 0.05$). In multivariate analysis, poor diet quality (AOR 2.58), low physical activity (AOR 2.14), low medication adherence (AOR 3.01), obesity, and diabetes duration ≥10 years remained significant independent predictors.

Conclusion

Poor glycemic control was highly prevalent among urban diabetic patients attending the UHTC. Dietary inadequacy, physical inactivity, and low medication adherence were major modifiable determinants of glycemic status. Strengthening urban primary-care interventions focusing on dietary counselling, physical activity promotion, and adherence support may substantially improve glycemic outcomes.

Keywords: Dietary pattern, Glycemic control, Physical activity, Medication adherence, Urban India.

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INTRODUCTION

Type 2 diabetes mellitus (T2DM) continues to rise globally, with a disproportionate burden in low- and middle-income countries. India accounts for one of the highest population burdens of T2DM, with an estimated 101 million affected individuals (1). Although diabetes was historically viewed as an urban-centric health problem, the urban–rural gap has

narrowed considerably over the last two decades, largely due to lifestyle transition, rapid urbanisation, and increased adoption of sedentary behaviours (2,3). Poor glycemic control remains a major challenge, contributing substantially to long-term microvascular and macrovascular complications. National evidence from the ICMR-INDIAB study shows that more than 60% of individuals with diabetes in India fail to achieve recommended glycemic targets (4).

Urban populations are uniquely vulnerable to lifestyle-related determinants of poor glycemic control. Urban dietary behaviour in South India is often characterised by frequent consumption of refined carbohydrates, calorie-dense street foods, and inadequate intake of fruits, vegetables, and fibre (5). These patterns contribute to post-meal hyperglycaemia and sustained glycemic dysregulation. Urbanisation also fosters reduced physical activity, driven by sedentary occupations, limited walkable spaces, and increased motorised transport use, all of which elevate diabetes risk and worsen glycemic outcomes (6).

Medication adherence is another critical determinant of glycemic control. Studies from Indian urban centres have demonstrated that inadequate adherence to oral hypoglycaemic agents and insulin correlates strongly with poor HbA1c outcomes (7,8). In urban settings, barriers to adherence frequently involve polypharmacy, perceived side-effects, complex dosing regimens, psychosocial stress, and poor continuity of care (9). Despite multiple studies examining individual lifestyle factors, limited research has simultaneously assessed the combined impact of dietary habits, physical activity, and medication adherence among urban patients attending primary-level teaching health facilities.

Given these gaps, the present study was conducted at an Urban Health & Training Centre (UHTC) to assess the association of dietary pattern, physical activity, and medication adherence with glycemic control among adults with T2DM. Understanding behavioural determinants within an urban teaching-centre context is essential for informing tailored interventions, strengthening urban primary healthcare, and supporting national NCD control strategies.

MATERIALS AND METHODS

This cross-sectional analytical study was carried out between January and December 2024 at the Urban Health & Training Centre (UHTC) attached to the Department of Community Medicine, Vinayaka Missions Kirupananda Variyar Medical College & Hospital, Salem, Tamil Nadu. Adults aged 18 years and above with a confirmed diagnosis of type 2 diabetes mellitus for at least one year and possessing a recent HbA1c report (within the previous three months) were included. Patients with type 1 diabetes, pregnant women, those with severe illness, and individuals unable to participate reliably were excluded.

The required sample was determined using the formula $n=Z^2PQ/d^2$,where Z is the standard normal deviate at 95% confidence (1.96), P is 64 based on the poor glycemic control prevalence reported in the ICMR-INDIAB study (4), $Q = 100 - P$, and d is the allowable error which is 5%, the minimum sample size was estimated at 354.To improve precision and accommodate exclusions, the research team implemented active recruitment strategies, including extended clinic sessions and follow-up reminders, to achieve a final sample of 402 participants. Systematic random sampling was employed by selecting every third eligible patient attending the UHTC's NCD clinic.

Data were collected using an interviewer-administered structured proforma. Dietary intake was assessed using the validated ICMR–NIN Food Frequency Questionnaire, enabling computation of the Diet Quality Index (DQI) (5). Physical activity was quantified using the WHO Global Physical Activity Questionnaire (GPAQ), which estimates MET-minutes per week across occupational, transport, and leisure domains (10). Medication adherence was evaluated with the 8-item Morisky Medication Adherence Scale (MMAS-8), a validated tool widely used in diabetes research (7). Anthropometric measurements followed standard procedures. Glycemic control was defined as HbA1c <7% (good control) and ≥7% (poor control), in accordance with ADA recommendations (11).

Data were analysed using SPSS version 26. Descriptive statistics summarised baseline variables. Associations between behavioural factors and glycemic control were examined using chi-square tests and independent t-tests. Multivariate logistic regression identified independent predictors after adjusting for age, sex, BMI, and duration of diabetes. Institutional Ethics Committee approval was obtained before data collection.

RESULTS

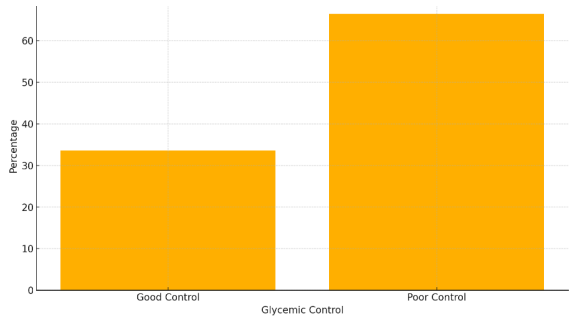
A total of 402 participants were enrolled, comprising predominantly middle-aged adults, with females forming a slightly higher proportion. Overweight and obesity were common, and nearly two-thirds of the

participants exhibited poor glycemic control based on HbA1c values. A substantial proportion had long-standing diabetes, with many reporting a duration exceeding ten years. These characteristics reflect the increasing metabolic burden observed among urban populations in South India (Table 1). Poor glycemic control constituted 66.4% of the study population, markedly exceeding the proportion with good control, as shown in the distribution (Figure 1).

Table 1. Sociodemographic and Clinical Characteristics of Participants (n = 402)

Variable	Category / Mean ± SD	n (%)
Age (years)	54.8 ± 10.2	—
Gender	Male	168 (41.8)
	Female	234 (58.2)
BMI (kg/m²)	26.9 ± 3.8	Overweight/obese ≥25: 244 (60.7)
Waist Circumference	94.2 ± 9.5 cm	Abdominal obesity: 271 (67.4)
Duration of Diabetes	9.1 ± 5.2 years	≥10 years: 176 (43.8)
Glycemic Control (HbA1c)	<7% (Good)	135 (33.6)
	≥7% (Poor)	267 (66.4)

Figure 1. Distribution of Glycemic Control Among Participants

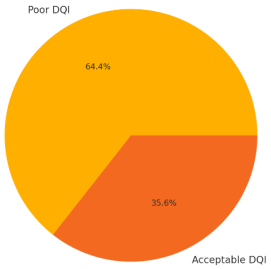


Dietary assessment revealed that most participants had poor diet quality, characterised by high intake of refined grains, insufficient fruit and vegetable consumption, frequent use of added sugars, and regular intake of fried foods. These urban dietary behaviours diverged considerably from recommended healthy patterns (Table 2). Poor diet quality accounted for the majority of the sample, highlighting suboptimal dietary practices (Figure 2).

Table 2. Dietary Pattern Characteristics Among Participants

Dietary Variable	Category	n (%)
Diet Quality Index	Poor (<50)	259 (64.4)
	Acceptable (≥50)	143 (35.6)
Refined Grain Intake	≥2 servings/day	311 (77.4)
Fruit & Vegetable Intake	<5 servings/day	322 (80.1)
Added Sugar Consumption	≥1 serving/day	215 (53.5)
High Fat/Oil Intake	Frequent fried foods	184 (45.8)

Figure 2. Distribution of Diet Quality Scores

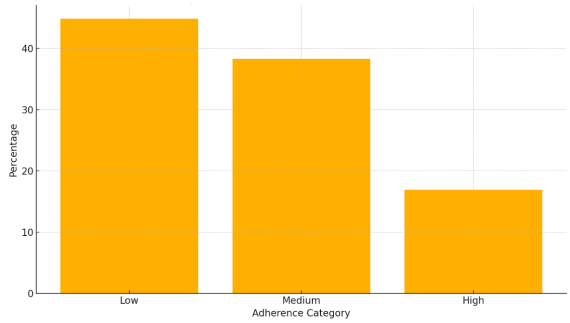


Nearly half of the participants reported low physical activity, with many engaged in sedentary or semi-sedentary occupations typical of urban environments. Medication adherence levels were also suboptimal, with low adherence being the most frequently reported. Only a minority achieved high adherence, reflecting behavioural challenges unique to urban health-seeking behaviour (Table 3; Figure 3).

Table 3. Physical Activity and Medication Adherence Patterns

Variable	Category	n (%)
Physical Activity (GPAQ)	Low (<600 MET-min/week)	194 (48.3)
	Moderate	147 (36.6)
	High	61 (15.2)
Medication Adherence (MMAS-8)	High	68 (16.9)
	Medium	154 (38.3)
	Low	180 (44.8)

Figure 3. Medication Adherence Levels



In bivariate analysis, poor diet quality, low physical activity, low medication adherence, elevated BMI, and longer diabetes duration were significantly associated with poor glycemic control (Table 4). Multivariate logistic regression confirmed that low medication adherence, poor diet quality, and low physical activity remained strong independent predictors, along with obesity and long-standing diabetes (Table 5). These findings underscore the behavioural determinants linked to urban diabetes management patterns.

Table 4. Associations Between Behavioural Factors and Glycemic Control

Variable	Poor Control n (%)	Good Control n (%)	p-value
Poor Diet Quality	204 (78.8)	55 (21.2)	<0.001
Low Physical Activity	143 (73.7)	51 (26.3)	0.002
Low Medication Adherence	147 (81.7)	33 (18.3)	<0.001
BMI ≥25 kg/m²	189 (77.5)	55 (22.5)	0.004
Diabetes Duration ≥10 years	138 (78.4)	38 (21.6)	<0.001

Table 5. Multivariate Logistic Regression for Predictors of Poor Glycemic Control

Predictor	AOR	95% CI	p-value
Poor Diet Quality	2.58	1.62–4.09	<0.001
Low Physical Activity	2.14	1.34–3.41	0.002
Low Medication Adherence	3.01	1.93–4.71	<0.001
BMI ≥25 kg/m²	1.67	1.08–2.58	0.021
Duration ≥10 years	2.21	1.39–3.52	0.001

DISCUSSION

This study found a high prevalence of poor glycemic control among adults with T2DM attending an urban primary healthcare facility, with nearly two-thirds exhibiting HbA1c ≥7%. Poor diet quality, low physical activity, and low medication adherence showed strong associations with poor glycemic control and remained significant predictors after adjusting for confounders. Overweight and obesity were additional contributors, reflecting the complex behavioural and metabolic determinants characteristic of urban populations.

The high prevalence of poor glycemic control in our study aligns with findings from South India. Mohan et al. showed that high glycaemic-load carbohydrate intake was associated with adverse metabolic outcomes among South Indian adults [12]. A tertiary-care study in South India further demonstrated that urban dietary transitions and sedentary lifestyles were major contributors to uncontrolled HbA1c among patients with type 2 diabetes [13]. These regional findings mirror the risk profile observed in our urban cohort and highlight the influence of diet and inactivity in worsening glycemic outcomes.

Our results are consistent with national evidence. The multicentre TIGHT study reported widespread suboptimal glycemic control across India and identified poor treatment adherence, obesity, and long disease duration as key predictors of high HbA1c levels [14]. These findings parallel our logistic regression results, where behavioural factors—poor diet, low physical activity, and poor medication adherence—remained independent determinants of poor glycemic control. Together, this reinforces the need for integrated behavioural counselling within Indian primary-care settings.

Comparable patterns have been documented across South Asia. In Sri Lanka, Katulanda et al. reported that poor lifestyle habits, including inadequate physical activity and unhealthy dietary patterns, were significantly associated with poor glycemic control [15]. In Nepal, Gyawali et al. demonstrated that non-adherence to medication was a strong independent predictor of inadequate glycemic control among patients with type 2 diabetes [16]. These findings indicate that behavioural determinants observed in our study align closely with those reported across South Asian populations.

Findings from international settings support our observations. In Ethiopia, Letta et al. identified poor adherence, excess body weight, and inadequate self-care practices as major correlates of poor glycemic

control among adults with type 2 diabetes [17]. Similar associations have been reported in other global studies, highlighting the universal significance of diet quality, physical activity, and medication adherence in achieving optimal glycemic outcomes. These studies reaffirm the global relevance of targeting behavioural determinants in diabetes management.

Strengths of this study include its sizeable sample, systematic random sampling, use of validated measurement tools, and adjustment for key confounders. However, being cross-sectional, it cannot infer causality. Dietary intake and adherence data were self-reported, which may introduce recall bias. The study was conducted in a single UHTC, which may limit generalisability to other urban populations.

CONCLUSION

This study highlights a substantial burden of poor glycemic control among adults with type 2 diabetes attending an Urban Health & Training Centre in South India. Poor diet quality, low physical activity, and inadequate medication adherence emerged as major behavioural determinants of suboptimal glycemic outcomes, while obesity and longer diabetes duration acted as additional contributing factors. These findings emphasise the critical need for integrated behavioural interventions within urban primary healthcare settings. Strengthening dietary counselling services, promoting structured physical activity initiatives, and implementing medication adherence support strategies have the potential to significantly improve metabolic outcomes among urban diabetic populations. The UHTC platform is particularly well-positioned to deliver such targeted interventions due to its accessibility, continuity of care, and community outreach capacity. Future research should include longitudinal assessments and multi-centre comparisons to better understand behavioural trajectories and intervention effectiveness across diverse urban populations. Investing in patient education, early risk factor modification, and lifestyle-oriented care models will be essential for addressing the growing diabetes burden in rapidly urbanising regions of India.

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