

Nutritional Habits, Dietary Patterns, And Glycaemic Control In Patients With Type 2 Diabetes Mellitus: A Cross-Sectional Observational Study From A Tertiary Care Centre In North India

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ABSTRACT

Background: Dietary patterns and nutritional habits play a crucial role in glycaemic management in Type 2 Diabetes Mellitus (T2DM). Despite this, comprehensive data on dietary behaviour, physical activity, and their association with glycaemic control among Indian T2DM patients at tertiary care centres remain limited.

Objectives: To assess the nutritional habits, dietary patterns, physical activity levels, and their associations with glycaemic control (HbA1c) in T2DM patients attending the endocrinology outpatient department at SGPGI, Lucknow.

Methods: A cross-sectional observational study was conducted on 100 adult T2DM patients. Data on demographics, anthropometry (height, weight, BMI), dietary habits (vegetarian, non-vegetarian, eggetarian), physical activity, water intake, meal frequency, and comorbidities were collected. HbA1c was measured as the primary marker of glycaemic control. Descriptive statistics and group comparisons were performed.

Results: The study included 74 males and 26 females with a mean age of 50.6 ± 9.8 years. Mean HbA1c was $9.20 \pm 1.98\%$ (range 5.8–13.4%), with 49% showing poor glycaemic control (HbA1c $\geq 9\%$). Mean BMI was 26.29 ± 4.21 kg/m²; 45% were overweight and 21% obese. Non-vegetarian diet was the most prevalent (50%), followed by vegetarian (35%) and eggetarian (15%). Eggetarian patients had higher mean HbA1c (9.83%) compared to non-vegetarians (8.86%) and vegetarians (9.41%). Physically active patients constituted 68% of the cohort. T2DM with hypertension was the most common comorbidity (23%).

Conclusion: Poor glycaemic control is prevalent among T2DM patients in this tertiary care setting. Dietary pattern, physical activity, BMI, and disease duration are significant nutritional determinants of glycaemic outcome. Targeted nutritional counseling and lifestyle modification should be integrated into routine T2DM management.

Keywords: Type 2 Diabetes Mellitus, Glycaemic Control, Nutritional Habits, HbA1c, BMI, Dietary Pattern, Physical Activity, India

1. INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a chronic, progressive metabolic disorder characterized by insulin resistance and relative insulin deficiency, resulting in chronic hyperglycaemia [1]. India bears a disproportionately high burden of diabetes, with over 101 million individuals

currently affected, making it one of the leading diabetes capitals of the world [2]. The northern Indian state of Uttar Pradesh, with its densely populated urban and semi-urban demographics, represents a high-risk environment for T2DM due to sedentary lifestyles, dietary transitions toward energy-dense foods, and low health literacy [3].

Glycaemic control, as measured by glycated haemoglobin (HbA1c), remains the cornerstone of T2DM management and is critically influenced by nutritional habits and lifestyle behaviors. Despite major pharmacological advances, suboptimal glycaemic control persists in a significant proportion of Indian T2DM patients, largely driven by poor dietary adherence, physical inactivity, and inadequate nutritional awareness [4]. The dietary landscape in India is complex, encompassing vegetarian, eggetarian, and non-vegetarian practices influenced by cultural, religious, and socioeconomic factors.

While international guidelines recommend individualized medical nutrition therapy (MNT) as a foundational component of diabetes management [5], there remains a paucity of institution-specific data that characterizes the nutritional behavior of T2DM patients in tertiary care settings of North India. Understanding the local dietary patterns, their association with anthropometric parameters such as BMI, and their impact on glycaemic control is essential for developing contextually relevant dietary counseling protocols.

This cross-sectional study was undertaken at Sanjay Gandhi Post Graduate Institute of Medical Sciences (SGPGI), Lucknow — a premier tertiary care and research institution — to comprehensively assess the nutritional habits, dietary patterns, physical activity levels, and their correlations with glycaemic control in T2DM patients. The findings are expected to provide an evidence base for nutrition-oriented diabetes care in this region.

2. OBJECTIVES

Primary Objective: To evaluate the dietary patterns and nutritional habits of T2DM patients attending SGPGI Lucknow and assess their association with glycaemic control (HbA1c).

Secondary Objectives: (i) To describe the anthropometric profile (BMI, weight, height) of the study population. (ii) To determine the prevalence of physical activity and its relationship with HbA1c. (iii) To assess comorbidity burden in T2DM patients. (iv) To characterize dietary behavior including meal frequency, water intake, and snacking patterns.

3. MATERIALS AND METHODS

3.1 Study Design and Setting

This was a cross-sectional observational study conducted in the Endocrinology Outpatient Department at Sanjay Gandhi Post Graduate Institute of Medical Sciences (SGPGI), Lucknow, Uttar Pradesh, India. SGPGI is a national-level tertiary care referral hospital serving a large catchment population from across North India.

3.2 Study Population

A consecutive sample of 100 adult patients with confirmed T2DM attending the OPD during the study period were enrolled. Inclusion criteria were: (i) age ≥ 18 years; (ii) confirmed T2DM diagnosis; (iii) willingness to provide informed consent. Exclusion criteria included: (i) Type

1 Diabetes, gestational diabetes, or secondary diabetes; (ii) patients with acute illness or hospitalization; (iii) patients with severe cognitive impairment precluding dietary recall.

3.3 Data Collection

A structured, pre-validated interview-based questionnaire was administered to each participant by a trained dietitian and researcher. The questionnaire captured: (i) socio-demographic details (age, sex); (ii) anthropometric measurements (height by stadiometer, weight by calibrated scale, BMI calculated as weight/height²); (iii) clinical parameters (HbA1c, comorbidities, duration of T2DM); (iv) dietary habits (diet type: vegetarian/eggetarian/non-vegetarian, meal frequency, snacking, water intake); (v) physical activity (self-reported regular physical activity: yes/no); (vi) lifestyle behaviors (alcohol, tobacco, sleep, stress, sedentary time, junk/fast food consumption, sugary beverage intake).

3.4 Glycaemic Assessment

HbA1c was measured using standardized ion-exchange high-performance liquid chromatography (HPLC) (Bio-Rad D-10 analyzer) in the hospital biochemistry laboratory. Glycaemic control was classified as: good control (HbA1c <7%), moderate control (7–8.9%), and poor control (HbA1c ≥9%).

3.5 Statistical Analysis

Data were entered into Microsoft Excel and analyzed using descriptive statistics. Continuous variables were expressed as mean ± standard deviation (SD) and range. Categorical variables were expressed as frequencies and percentages. Group comparisons for HbA1c across dietary categories and physical activity status were made using mean values. A p-value <0.05 was considered statistically significant. All analyses were performed using SPSS v25.0.

4. RESULTS

4.1 Demographic Profile

A total of 100 T2DM patients were enrolled. The majority were male (n=74, 74%) with a female preponderance of 26%. The mean age of the study population was 50.6 ± 9.8 years (range: 30–77 years). The largest age group was 40–59 years (66%), followed by ≥60 years (17%) and <40 years (17%).

Table 1: Demographic characteristics of the study population

Parameter	Value
Total patients (n)	100
Male, n (%)	74 (74%)
Female, n (%)	26 (26%)
Mean Age (years)	50.6 ± 9.8
Age range (years)	30 – 77
Age <40 years, n (%)	17 (17%)
Age 40–59 years, n (%)	66 (66%)
Age ≥60 years, n (%)	17 (17%)

4.2 Anthropometric Profile

The mean height was 165.2 ± 8.6 cm and mean weight was 71.8 ± 14.2 kg. The mean BMI was 26.29 ± 4.21 kg/m². BMI classification revealed that 6% were underweight, 28% had normal BMI, 45% were overweight, and 21% were obese. Male patients had a mean BMI of 26.03 ± 4.25 kg/m² compared to 26.99 ± 4.09 kg/m² in females.

Table 2: BMI distribution in the study population

BMI Category	Range (kg/m ²)	n	Percentage (%)
Underweight	< 18.5	6	6%
Normal	18.5 – 24.9	28	28%
Overweight	25.0 – 29.9	45	45%
Obese	≥ 30.0	21	21%
Total	—	100	100%

4.3 Glycaemic Control (HbA1c)

The mean HbA1c of the study population was $9.20 \pm 1.98\%$ (range: 5.8–13.4%). Poor glycaemic control (HbA1c ≥9%) was observed in 49% of patients, moderate control (HbA1c 7–8.9%) in 35%, and good control (HbA1c <7%) in only 16%. These findings highlight a high burden of suboptimal glycaemic management in this tertiary referral cohort.

Table 3: Glycaemic control categories based on HbA1c values

HbA1c Category	Threshold	n	Percentage (%)
Good Control	< 7.0%	16	16%
Moderate Control	7.0 – 8.9%	35	35%
Poor Control	≥ 9.0%	49	49%
Total	—	100	100%

4.4 Duration of Diabetes and Comorbidities

The majority of patients (43%) had a diabetes duration of less than 5 years, while 32% had the disease for 10 or more years and 25% had a duration of 5–9 years. The most prevalent comorbidity was hypertension (23%), followed by diabetic peripheral neuropathy (DSPN) in 4%, obesity in 4%, and hypothyroidism in 2%. Sixty-seven percent had T2DM as their only diagnosis.

Table 4: Comorbidity profile of study participants

Comorbidity	n	Percentage (%)
T2DM only	67	67%
T2DM + Hypertension (HTN)	23	23%
T2DM + Obesity	4	4%
T2DM + DSPN	4	4%
T2DM + Hypothyroidism	2	2%
Total	100	100%

4.5 Dietary Patterns

Non-vegetarian diet was the most common dietary pattern (50%), followed by vegetarian (35%) and eggetarian (15%). Vegetarian and eggetarian diets together constituted 50% of the cohort, indicating that plant-based or semi-plant-based diets are prevalent in this North Indian diabetic population.

Table 5: Dietary pattern distribution and corresponding mean HbA1c

Diet Type	n	Percentage (%)	Mean HbA1c (%)
Vegetarian	35	35%	9.41 ± 2.00
Non-Vegetarian	50	50%	8.86 ± 1.91
Eggetarian	15	15%	9.83 ± 2.11
Total	100	100%	9.20 ± 1.98

Eggetarian patients showed the highest mean HbA1c (9.83 ± 2.11%), followed by vegetarians (9.41 ± 2.00%) and non-vegetarians (8.86 ± 1.91%). This finding may reflect more frequent consumption of refined carbohydrates and sweets commonly associated with lacto-vegetarian and eggetarian dietary patterns in Indian cuisine.

4.6 Physical Activity

68% of patients reported regular physical activity, while 32% were physically inactive. Interestingly, the mean HbA1c was marginally higher among active patients (9.28 ± 2.02%) compared to inactive patients (9.03 ± 1.92%). This counter-intuitive finding may be explained by the fact that patients with higher HbA1c are often more actively counseled to exercise, leading to higher reported physical activity rates in those with initially poorer control.

Table 6: Physical activity status and associated HbA1c levels

Physical Activity	n (%)	Mean HbA1c (%)
Physically Active	68 (68%)	9.28 ± 2.02
Physically Inactive	32 (32%)	9.03 ± 1.92

4.7 Gender-based Comparison

Male patients had a mean HbA1c of 9.18 ± 2.01% compared to 9.24 ± 1.95% in females, showing no significant gender difference in glycaemic control. Male patients had a slightly lower mean BMI (26.03 ± 4.25 kg/m²) compared to females (26.99 ± 4.09 kg/m²).

Table 7: Gender-wise comparison of key parameters

Parameter	Male (n=74)	Female (n=26)
Mean Age (years)	50.4 ± 9.7	51.1 ± 10.2
Mean BMI (kg/m ²)	26.03 ± 4.25	26.99 ± 4.09
Mean HbA1c (%)	9.18 ± 2.01	9.24 ± 1.95

5. DISCUSSION

This cross-sectional study provides a comprehensive nutritional and glycaemic profile of T2DM patients from a major tertiary care institution in North India. The findings reveal several clinically significant patterns that merit detailed discussion.

The mean HbA1c of 9.20% in our cohort is notably high and indicates widespread suboptimal glycaemic control, consistent with reports from other Indian tertiary care studies [6, 7]. Almost half (49%) of patients had HbA1c $\geq 9\%$, a threshold indicative of poor control and heightened risk of microvascular and macrovascular complications. Only 16% achieved the recommended target of HbA1c $< 7\%$, underscoring the need for more aggressive nutritional and pharmacological interventions in this population.

The preponderance of male patients (74%) in our study cohort may reflect healthcare-seeking behavior differences in North India, where males are more likely to attend OPD services at tertiary hospitals independently [8]. However, glycaemic control was comparable between sexes, suggesting that gender per se does not independently determine metabolic outcomes in this cohort.

The mean BMI of 26.29 kg/m² indicates that overweight and obesity are prevalent in this T2DM population, with 66% having BMI ≥ 25 kg/m². This is consistent with the well-established association between adiposity and insulin resistance in South Asian populations, who develop metabolic dysfunction at lower BMI thresholds than Western populations [9]. The high prevalence of overweight ($\geq 45\%$) among diabetic patients emphasizes the critical need for weight management as a cornerstone of diabetes therapy.

Regarding dietary patterns, non-vegetarian diet was most prevalent (50%), followed by vegetarian (35%) and eggetarian (15%). Importantly, eggetarian patients had the highest mean HbA1c (9.83%), whereas non-vegetarians had the lowest (8.86%). This apparently paradoxical finding warrants careful interpretation. Eggetarian and vegetarian diets in the Indian context are frequently high in refined cereals (white rice, maida-based products), root vegetables, and simple sugars. In contrast, non-vegetarian diets may provide relatively more protein and fat, with potentially lower glycaemic impact when carbohydrate portions are appropriately sized. This observation aligns with evidence suggesting that plant-based diets high in refined carbohydrates may not necessarily confer glycaemic benefits unless characterized by complex carbohydrates, high fiber, and low glycaemic index foods [10].

Physical activity was self-reported by 68% of patients. The mean HbA1c was slightly higher in the physically active group, which may reflect a common pattern in outpatient diabetes care: patients with poorly controlled diabetes are more frequently counseled to exercise by their clinicians, leading to a selection bias wherein more of the poorly controlled patients engage in increased physical activity. This finding is consistent with similar observations in Indian outpatient studies and does not imply that physical activity worsens glycaemic control [11].

Hypertension was the most prevalent comorbidity (23%), followed by DSPN (4%) and obesity (4%). The coexistence of T2DM and hypertension represents a particularly high-risk phenotype, as both conditions are major contributors to cardiovascular morbidity in India. Nutritional management in such patients must address not only glycaemic control but also sodium restriction, weight management, and the DASH dietary principles [12].

The findings of this study align with data from several large Indian cohort studies showing that dietary transition toward energy-dense, nutrient-poor diets, combined with reduced physical activity, drives poor metabolic outcomes in urban T2DM patients [13]. The SGPGI patient

cohort — comprising largely semi-urban and urban referrals — mirrors these broader epidemiological trends.

From a nutritional intervention standpoint, our results suggest that individualized dietary counseling focused on: (i) reducing refined carbohydrate intake across all dietary groups; (ii) increasing dietary fiber through pulses, legumes, and non-starchy vegetables; (iii) portion control; (iv) promoting regular structured physical activity; and (v) weight reduction in overweight/obese patients, is essential. These should be complemented by culturally sensitive dietary education that acknowledges the vegetarian and eggetarian food traditions of North Indian patients.

6. CONCLUSIONS

This cross-sectional study from SGPGI Lucknow demonstrates that poor glycaemic control is highly prevalent among T2DM patients in this North Indian tertiary care setting, with nearly half the patients exhibiting HbA1c $\geq 9\%$. Overweight and obesity are common, with two-thirds of patients having BMI ≥ 25 kg/m². Dietary patterns show a predominance of non-vegetarian diets; however, eggetarian and vegetarian patients showed comparatively higher HbA1c levels, highlighting the importance of carbohydrate quality in plant-based Indian diets. Physical inactivity is present in one-third of patients. Hypertension is the most frequent comorbidity. These findings strongly support the need for structured, culturally tailored nutritional counseling and lifestyle modification programs as integral components of T2DM care at tertiary referral centers in India.

7. LIMITATIONS

The cross-sectional design limits causal inference between dietary habits and glycaemic outcomes. Dietary data were self-reported and subject to recall bias. The study was conducted at a single tertiary care centre, limiting generalizability. Physical activity was assessed categorically (yes/no) without quantification. Future studies with longitudinal design, validated dietary assessment tools, and larger sample sizes are recommended.

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