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MULTIMORBIDITY BURDEN AND CARDIOMETABOLIC RISK PROFILES IN URBAN INDIAN TYPE 2 DIABETICS: A CROSS-SECTIONAL ANALYSIS

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ABSTRACT

Background: Type 2 diabetes mellitus (T2DM) in India disproportionately presents with multiple concurrent non-communicable diseases (NCDs). Urban populations in Central India, particularly in the Vidarbha region, represent an understudied yet rapidly growing cohort with unique cardiometabolic risk profiles. This study aimed to assess the burden of multimorbidity and associated cardiometabolic parameters among T2DM patients enrolled in a structured chronic care programme in Nagpur, Maharashtra. **Methods:** A cross-sectional analysis was conducted using clinical records of 76 unique T2DM patients attending the GTT Diabetes & Lifestyle Care Centre, Nagpur (Vidharbha RIC) between April 2025 and April 2026. Sociodemographic, clinical, anthropometric, biochemical, and pharmacological data were extracted. Multimorbidity was defined as the co-occurrence of two or more chronic conditions in addition to T2DM. Descriptive statistics and frequency analysis were performed. **Results:** The mean age of participants was 51.4 ± 9.5 years (range: 33–75 years); 57.9% were male. Multimorbidity was present in 61.8% (n=47) of patients. The most prevalent comorbidities were hypertension (40.8%), obesity (31.6%), dyslipidaemia (10.5%), ischaemic heart disease (IHD) (9.2%), coronary artery disease (CAD) (6.6%), and hypothyroidism (6.6%). Mean baseline HbA1c was 8.39 ± 2.03%, mean BMI was 26.6 ± 4.3 kg/m², and mean systolic blood pressure was 124.8 ± 13.7 mmHg. Patients with ≥4 comorbidities exhibited markedly elevated cardiometabolic risk parameters including higher polypharmacy burden (up to 42 medications dosage units). **Conclusion:** Multimorbidity is highly prevalent among urban Indian T2DM patients in Central India. The compounding burden of hypertension, obesity, and cardiovascular diseases significantly elevates cardiometabolic risk. Structured multidisciplinary care models are urgently needed to address this complex disease burden. These findings provide essential real-world data to inform clinical practice guidelines and public health policy in the Central Indian urban context.

KEYWORDS: Type 2 diabetes mellitus, multimorbidity, cardiometabolic risk, urban India, Vidarbha, hypertension, obesity, chronic care programme, cross-sectional study, HbA1c.

1. INTRODUCTION

India is confronting an unprecedented epidemic of non-communicable diseases (NCDs), with type 2 diabetes mellitus (T2DM) at its epicentre. According to the International Diabetes Federation (IDF) Diabetes Atlas 2021, India accounts for approximately 74 million diabetic individuals, making it the second-largest diabetic population globally. Projections suggest this number will rise to over 124 million by 2045, representing a severe burden on the Indian healthcare system.[1, 2]

A distinctive and clinically critical feature of T2DM in the South Asian context is the phenomenon of multimorbidity — defined as the simultaneous presence of two or more chronic conditions — which occurs at younger ages and lower body mass indices (BMI) compared to Western counterparts.[3,4] Multimorbidity in diabetic patients is strongly associated with worsened glycaemic control, increased cardiovascular events, higher rates of hospitalisation, polypharmacy, reduced quality of life, and significantly elevated healthcare costs.[5, 6]

The urban population of Central India, particularly in the Vidarbha region of Maharashtra, presents a unique epidemiological landscape. Rapid urbanisation, increasingly sedentary lifestyles, dietary transition toward processed foods, high occupational stress, and genetic predisposition contribute to an accelerated cardiometabolic risk trajectory in this population.[7] Importantly, this region remains relatively understudied compared to metropolitan cities such as Mumbai, Delhi, and Chennai, creating a critical knowledge gap in existing literature.

Previous studies have examined multimorbidity in T2DM patients in Western and South Asian populations, but evidence from structured real-world chronic care programmes in Central Indian urban settings is scarce.[8, 9] Understanding the cardiometabolic burden in this population — including the prevalence and patterns of comorbid hypertension, obesity, dyslipidaemia, coronary artery disease (CAD), ischaemic heart disease (IHD), chronic kidney disease (CKD), and congestive heart failure (CHF) — is essential for informing targeted clinical and public health interventions.

This study, therefore, aimed to: (1) determine the prevalence of multimorbidity among urban T2DM patients enrolled in a structured care programme in Nagpur, Maharashtra; (2) describe baseline cardiometabolic risk profiles including anthropometric, glycaemic, blood pressure, and lipid parameters; and (3) characterise the patterns of comorbidity clusters in this population. The findings of this study provide valuable real-world clinical evidence that can guide clinicians, public health practitioners, and policymakers in addressing the growing NCD burden in Central India.

2. MATERIALS AND METHODS

2.1 Study Design and Setting

A cross-sectional analytical study was conducted using retrospective clinical data extracted from the GTT Diabetes & Lifestyle Care Centre, Nagpur (Vidharbha Regional Integrated Care, Medical Square), Maharashtra, India. This is a structured outpatient chronic care programme offering multidisciplinary diabetes management including medical consultation, dietary counselling, exercise prescription, and patient education. Data were collected from April 2025 to April 2026.

2.2 Study Population

The study included all adult patients (age ≥18 years) with a confirmed diagnosis of T2DM who were enrolled in any care plan at the centre during the study period. Records with completely missing clinical data were excluded. After deduplication, a final sample of 76 unique patients was included in the analysis.

2.3 Data Collection

Patient data were extracted from the institutional electronic medical record system (GTT ERP/CMS). Variables collected included: sociodemographic characteristics (age, sex); clinical diagnoses (T2DM, hypertension, obesity, dyslipidaemia, IHD, CAD, CHF, CKD, hypothyroidism, anaemia); anthropometric parameters (weight, BMI, abdominal girth); glycaemic indices (fasting/random blood sugar [RBS], HbA1c); cardiovascular parameters (systolic blood pressure [SBP], diastolic blood pressure [DBP], heart rate [HR]); lipid profile (total cholesterol, LDL-C, HDL-C, triglycerides); functional fitness (VO_2Max, 6-minute walk distance); and care plan type (Navjeevan Care Plan, DM Packages, Diet Care Plans).

2.4 Definitions

Multimorbidity was defined as the presence of two or more concurrent chronic conditions in a single patient (inclusive of T2DM). Obesity was defined as BMI ≥30 kg/m² (WHO criteria) or clinical diagnosis recorded in the medical record. Hypertension was defined based on clinical diagnosis or blood pressure ≥130/80 mmHg (AHA/ACC 2017 guidelines). Dyslipidaemia was diagnosed based on lipid profile abnormalities or clinical documentation. Polypharmacy was defined as concurrent use of five or more medications.

2.5 Statistical Analysis

Data were analysed using descriptive statistics. Continuous variables are expressed as mean ± standard deviation (SD) and range. Categorical variables are expressed as frequencies and percentages. Comorbidity burden was stratified by number of concurrent conditions (0, 1, 2, 3, ≥4). Cardiometabolic parameters were compared across sex categories. All analyses were performed using Python 3.x with the openpyxl and statistics libraries.

2.6 Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki (2013 revision). Patient data were anonymised prior to analysis. All identifiable information (names, contact numbers) was removed from the analytical dataset. Institutional ethics clearance was obtained from [Ethics Committee Name, Reference Number]. Since this was a retrospective analysis of de-identified clinical records, individual informed consent was waived.

3. RESULTS

3.1 Sociodemographic Profile

A total of 76 unique T2DM patients were included in the final analysis. The mean age was 51.4 ± 9.5 years (range: 33–75 years). The study population comprised 44 males (57.9%) and 32 females (42.1%), yielding a male-to-female ratio of approximately 1.4:1. All patients were urban residents from the Nagpur metropolitan region (Vidarbha, Central India). The majority of patients were enrolled under DM Packages (n=41, 53.9%), followed by Navjeevan Care Plan (n=27, 35.5%), and Diet Care Plans (n=8, 10.5%). Table 1 presents the complete sociodemographic profile.

Table 1: Sociodemographic and Care Plan Profile of Study Participants (N=76)

Parameter	Category	n (%)	Notes
Age (years)	Mean ± SD	51.4 ± 9.5	Range: 33–75
	20–40 years	4 (5.3%)	Younger adults
	41–60 years	58 (76.3%)	Majority cohort
	>60 years	14 (18.4%)	Elderly cohort
Sex	Male	44 (57.9%)	
	Female	32 (42.1%)	
Care Plan	DM Packages	41 (53.9%)	CDC SP / KP plans
	Navjeevan Care Plan	27 (35.5%)	Structured follow-up
	Diet Care Plans	8 (10.5%)	Nutrition-only plans
Region	Vidharbha RIC, Nagpur	76 (100%)	Urban Central India

3.2 Prevalence and Pattern of Multimorbidity

Multimorbidity (defined as ≥2 concurrent chronic conditions) was present in 47 patients (61.8%). The distribution of comorbidity burden is shown in Table 2. Only 14 patients (18.4%) had no recorded comorbid diagnosis, and 15 patients (19.7%) had a single comorbidity. A substantial proportion of patients (34.2%) had 2 concurrent conditions, while 15.8% had 3 conditions. Notably, 9 patients (11.8%) had ≥4 concurrent conditions, with one patient carrying a six-condition comorbidity burden (DM, Hypertension, Anaemia, CKD, CHF, IHD).

Among males, multimorbidity prevalence was 65.9% (29/44), compared to 56.2% (18/32) in females, suggesting a higher multimorbidity burden in males, though this difference requires further investigation in larger samples.

Table 2: Distribution of Comorbidity Burden Among Study Participants.

No. of Concurrent Conditions	No. of Patients	Percentage (%)	Category
0	14	18.4%	No comorbidity
1	15	19.7%	Single comorbidity
2	26	34.2%	Multimorbidity
3	12	15.8%	Multimorbidity
4	5	6.6%	High multimorbidity

No. of Concurrent Conditions	No. of Patients	Percentage (%)	Category
5	1	1.3%	Very high multimorbidity
6	3	3.9%	Very high multimorbidity
Total with ≥2 conditions	47	61.8%	Multimorbid group

3.3 Individual Comorbidity Prevalence

Among the 76 patients, hypertension was the most prevalent comorbidity (n=31, 40.8%), followed by obesity (n=24, 31.6%), dyslipidaemia (n=8, 10.5%), IHD (n=7, 9.2%), CAD (n=5, 6.6%), hypothyroidism (n=5, 6.6%), CHF (n=3, 3.9%), anaemia (n=2, 2.6%), and CKD (n=1, 1.3%). The complete prevalence data are presented in Table 3.

Table 3: Prevalence of Individual Comorbidities Among T2DM Patients (N=76)

Comorbidity	No. of Patients (n)	Prevalence (%)	Clinical Implication
Hypertension	31	40.8%	Highest prevalence; major CV risk
Obesity (clinical/BMI≥30)	24	31.6%	Metabolic driver
Dyslipidaemia	8	10.5%	Atherosclerotic risk
Ischaemic Heart Disease (IHD)	7	9.2%	Major cardiac event risk
Coronary Artery Disease (CAD)	5	6.6%	Atherosclerotic disease
Hypothyroidism	5	6.6%	Metabolic-glycaemic interaction
Congestive Heart Failure (CHF)	3	3.9%	Advanced cardiac complication
Anaemia	2	2.6%	HbA1c confounding factor
Triple Vessel Disease (TVD)	2	2.6%	Severe CAD variant
Chronic Kidney Disease (CKD)	1	1.3%	Diabetic nephropathy
Low Ejection Fraction	1	1.3%	Severe cardiomyopathy

3.4 Baseline Cardiometabolic Risk Parameters

Table 4 presents the baseline cardiometabolic risk parameters for the study population. The mean baseline BMI was 26.6 ± 4.3 kg/m², indicating an overweight status for the cohort as a whole. BMI categorisation revealed that 39.5% were overweight (BMI 25–29.9 kg/m²) and 19.7% were obese (BMI ≥30 kg/m²), together accounting for nearly 60% of the cohort having excess body weight. Mean HbA1c was 8.39 ± 2.03%, reflecting suboptimal glycaemic control at baseline. Mean systolic blood pressure (SBP) was 124.8 ± 13.7 mmHg, and mean random blood glucose (RBS) was 221.8 mg/dL.

Table 4: Baseline Cardiometabolic Risk Parameters (N=76)

Parameter	Mean ± SD	n with Data	Reference Range
Weight (kg)	70.9 ± 14.2	60	—
BMI (kg/m²)	26.6 ± 4.3	60	18.5–24.9 (Normal)
Abdominal Girth (cm)	97.0 ± 10.5	58	<90 (M), <80 (F)
HbA1c (%)	8.39 ± 2.03	54	<7.0 (Controlled)

Parameter	Mean ± SD	n with Data	Reference Range
Random Blood Sugar (mg/dL)	221.8 ± 84.3	56	<200 mg/dL
Systolic BP (mmHg)	124.8 ± 13.7	60	<130 mmHg
Diastolic BP (mmHg)	81.0 ± 9.2	60	<80 mmHg
Heart Rate (bpm)	82.4 ± 14.1	58	60–100 bpm
Total Cholesterol (mg/dL)	184.8 ± 68.6	7	<200 mg/dL
LDL-C (mg/dL)	96.0 ± 38.2	24	<100 mg/dL
HDL-C (mg/dL)	40.9 ± 7.8	6	>40 (M), >50 (F)
Triglycerides (mg/dL)	164.0 ± 74.5	6	<150 mg/dL

3.5 BMI Distribution and Nutritional Status

Analysis of baseline BMI data (n=60) revealed a diverse nutritional profile. Only 2.6% were underweight (BMI <18.5 kg/m²), while 17.1% had normal BMI (18.5–24.9 kg/m²). The majority — 39.5% — were overweight (BMI 25–29.9 kg/m²), and 19.7% were frankly obese (BMI ≥30 kg/m²). This finding is clinically significant as a substantial proportion of Indian T2DM patients develop complications even in the overweight BMI range, corroborating the concept of the 'thin-fat' Indian phenotype characterised by excess visceral adiposity at comparatively lower BMI thresholds.

Table 5: BMI Category Distribution (Baseline, n=60)

BMI Category	BMI Range (kg/m²)	No. of Patients	Percentage (%)
Underweight	<18.5	2	3.3%
Normal weight	18.5–24.9	13	21.7%
Overweight	25.0–29.9	30	50.0%
Obese Class I	30.0–34.9	12	20.0%
Obese Class II+	≥35.0	3	5.0%
Total	—	60	100%

3.6 Polypharmacy Burden

Assessment of medication burden at baseline revealed significant polypharmacy across the cohort. Patients with multiple comorbidities were often on 3 to 8 concurrent medications on Day 1, with the most complex patients carrying dosage burdens of up to 42 tablet-equivalents per day (observed in a patient with DM, Hypertension, Anaemia, CKD, CHF, and IHD). Medicines commonly prescribed included oral hypoglycaemic agents (metformin, sitagliptin, glimepiride, dapagliflozin, gliclazide), antihypertensives (telmisartan, amlodipine, metoprolol), statins (atorvastatin, rosuvastatin), antiplatelets (aspirin, clopidogrel), and thyroid medications. During the care programme, a notable proportion of patients achieved meaningful medication reduction (mean reduction percentage among those with available data: approximately 30–75%), suggesting the programme's effectiveness in facilitating medication de-escalation.

4. DISCUSSION

This cross-sectional study presents a detailed real-world characterisation of multimorbidity burden and cardiometabolic risk profiles among urban T2DM patients enrolled in a structured chronic care programme in Nagpur, Central India. The key findings are: (1) multimorbidity is highly prevalent, affecting 61.8% of the study population; (2) hypertension (40.8%) and obesity (31.6%) are the dominant comorbidities; (3) baseline glycaemic control is suboptimal (mean HbA1c 8.39%); and (4) a substantial proportion of patients carry a high polypharmacy burden, reflecting advanced disease complexity.

The prevalence of multimorbidity (61.8%) in our cohort is consistent with, and in some cases exceeds, previously reported rates in T2DM populations. A nationwide study in India by Tripathy et al. reported multimorbidity rates of 55–68% in diabetic outpatients.[10] Our findings align with the CARRS (Centre for Cardiometabolic Risk Reduction in South Asia) cohort study, which reported

extremely high rates of comorbid hypertension and dyslipidaemia in South Asian urban diabetics.[11] The high prevalence in our cohort likely reflects the advanced stage of disease at presentation, as well as the selection bias towards more complex patients seeking specialised structured care.

The prevalence of hypertension (40.8%) as the leading comorbidity aligns with published literature. A meta-analysis by Tiwaskar et al. estimated hypertension coexistence in T2DM Indian patients at approximately 50–60% in clinic-based settings.[12] The slightly lower rate in our cohort may reflect inclusion of younger patients (minimum age 33 years) and those in early disease stages. The physiological coupling of T2DM and hypertension through insulin resistance, renin-angiotensin-aldosterone system (RAAS) hyperactivation, and sympathetic overdrive underscores the critical need for dual-disease management protocols.[13]

Obesity prevalence (31.6%) in this cohort, when combined with the overweight category, means nearly 60% of patients had excess body weight. This is particularly concerning in the Indian context, where the WHO Asia-Pacific BMI cut-offs (23 kg/m² for overweight risk, 27.5 kg/m² for obesity risk) are more relevant than standard WHO thresholds.[14] When applying these adjusted thresholds, the true burden of excess adiposity in our cohort would be considerably higher, reinforcing the concept of metabolically obese normal weight (MONW) or the 'thin-fat Indian' phenotype described by Yajnik et al.[15]

Cardiovascular comorbidity — including IHD (9.2%), CAD (6.6%), and CHF (3.9%) — was notable given the relatively young mean age (51.4 years) of our cohort. This supports the well-established epidemiological finding that South Asians develop premature atherosclerotic cardiovascular disease (ASCVD), often a decade earlier than Western counterparts.[16] The clustering of DM, hypertension, dyslipidaemia, and obesity in the same patients creates a synergistic 'perfect storm' for accelerated cardiovascular morbidity.

Baseline HbA1c of 8.39% indicates significant glycaemic under-treatment at enrolment. International T2DM management guidelines (ADA 2024, RSSDI 2023) recommend a target HbA1c of <7.0% for most adults without significant comorbidities, and <8.0% for those with advanced multimorbidity. The majority of patients in this cohort exceeded even the more lenient target, highlighting a critical gap in glycaemic management in real-world Indian clinical settings.[17, 18]

The polypharmacy burden documented in this study is a direct consequence of multimorbidity. The most complex patients were on 8–12 concurrent medications, which is associated with poor medication adherence, drug-drug interactions, adverse drug reactions, and significantly higher direct medical costs. The structured care programme at this centre was observed to achieve meaningful medication de-escalation in several patients, suggesting that intensive lifestyle intervention, dietary modification, and structured exercise can complement pharmacotherapy and potentially enable judicious drug reduction — a finding that warrants prospective investigation.[19]

Several limitations of this study should be acknowledged. First, the cross-sectional design precludes causal inference. Second, the sample size (n=76) is relatively small and from a single centre, limiting generalisability. Third, lipid profile data were available only for a subset of patients, which restricts comprehensive dyslipidaemia characterisation. Fourth, data on patient education levels, dietary habits, physical activity, smoking, and alcohol status — important confounders — were not systematically captured. Future longitudinal studies with larger multicentre samples and comprehensive socioeconomic and lifestyle data are needed to validate and extend these findings.

5. CONCLUSION

This study demonstrates a high burden of multimorbidity (61.8%) and suboptimal cardiometabolic risk profiles among urban T2DM patients in Central India. Hypertension, obesity, dyslipidaemia, and cardiovascular diseases are the dominant comorbidities, occurring at a relatively young age and compounding the complexity of clinical management. These findings underscore the urgent need for:

- Integrated, multidisciplinary chronic care models that simultaneously address glycaemic, cardiovascular, and metabolic risk factors.
- Population-specific clinical guidelines employing Asia-Pacific BMI thresholds and HbA1c targets appropriate to multimorbid patients.
- Structured lifestyle intervention programmes (diet, exercise, behaviour change) as cornerstone therapies to potentially enable medication de-escalation.
- Regional epidemiological surveillance systems to monitor the evolving NCD burden in Central Indian urban populations.

The GTT Diabetes & Lifestyle Care Centre Nagpur model of structured multidisciplinary care offers a promising template for addressing this growing health challenge. Multicentre prospective studies with expanded sample sizes are essential to generate robust evidence for policy-level interventions in the Vidarbha region and comparable Central Indian urban settings.

Author Declarations

Conflict of Interest: The authors declare no conflict of interest.

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Data Availability: The de-identified data supporting the findings of this study are available from the corresponding author upon reasonable request.

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