

Assessment of the Cost of Illness Associated with Type 2 Diabetes

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ABSTRACT

Background: Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder associated with significant clinical and economic burden worldwide. Diabetes increases preventable sickness and costs to healthcare and productivity. Type 2 diabetes and macrovascular consequences cause most diabetes-related costs. Type 2 diabetes imposes high costs on healthcare institutions, reducing economic productivity and efficiency. This Cost-of-Illness (COI) analysis examines the direct and indirect costs of treating and managing type 2 diabetes mellitus. **Objectives:** To estimate the Cost of Illness (COI) associated with T2DM management. **Materials and Methods:** A prospective, observational, prevalence-based cost-of-illness study was conducted in five diabetic clinics in Suryapet town, Telangana, over a 6-month period. A total of 100 patients with type 2 diabetes mellitus were enrolled. Direct medical and non-medical costs were calculated using a bottom-up micro-costing approach. **Results:** About 100 patients with type 2 diabetes were enrolled in the study. Among them were 50 males (30 with complications +20 without complications) and 50 females (33 with complications +17 without complications). The mean age of enrolled patients was 56.2 years, and the disease duration was 10.1 ± 5.9 years. The annual cost per patient with complications was ₹44,417.68 (US\$510.96) compared to ₹27,804.96 (US\$319.68) for patients without complications. Medication and laboratory costs accounted for the largest share of direct costs. Regression analysis identified complications, insulin therapy and hospitalisation as major predictors of increased total cost. **Conclusion:** The economic burden of T2DM is substantial and increases significantly with complications. Strengthening preventive strategies, such as the presence of a clinical pharmacist in pharmacotherapeutic management, reduces out-of-pocket expenditure.

Keywords: Bottom-up micro costing, Clinical pharmacist, Cost of illness, Direct cost, Indirect cost, Type 2 Diabetes Mellitus.

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INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder characterised by persistent hyperglycemia resulting from insulin resistance, impaired insulin secretion, or both. The global prevalence of diabetes has risen dramatically in recent decades, making it a major public health concern with significant clinical and economic implications. Beyond its well-known complications, T2DM imposes a substantial financial burden on individuals, healthcare systems, and national economies due to its lifelong management requirements. (Bansal 2025, Prathyusha 2025).

Cost-of-Illness (COI) studies are widely used to estimate the economic burden of diseases by evaluating direct medical, direct

non-medical, and indirect costs. In the context of diabetes, these costs include expenditure on medications, laboratory investigations, physician consultations, hospitalisation, transportation, and productivity losses (Rawat, 2024). Evidence from global and national studies consistently demonstrates that diabetes is associated with high and rising healthcare expenditures. For instance, economic analyses in the United States estimated the total cost of diabetes at over \$400 billion, with individuals incurring medical expenditures nearly 2.6 times higher than those without diabetes (Olickal, 2023). Similarly, studies in lower- and middle-income countries highlight that diabetes places a considerable burden even in resource-constrained settings (Sathyanath, 2022).

In India, the economic burden of T2DM is particularly concerning due to the predominance of out-of-pocket healthcare spending. Several recent studies have reported significant variability in annual expenditure, ranging from approximately ₹5,000 to over ₹17,000 per patient, depending on disease severity, comorbidities, and healthcare utilisation (Nagarathna, 2021). Direct medical costs, particularly medications, constitute the



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largest component, while indirect costs, such as productivity loss, contribute significantly to the overall burden (Deshpande *et al.*, 2025). Importantly, studies have also reported catastrophic health expenditure and financial hardship among patients, especially in low-income and vulnerable populations (Bansal 2025; Prathyusha 2025).

Diabetes-related complications further worsen the economic burden. Conditions such as cardiovascular disease, nephropathy, and diabetic foot complications significantly boost treatment costs, often resulting in hospitalisation and long-term care expenses (8). Moreover, factors like the duration of illness, insulin use, and dependence on private healthcare services have been recognised as key determinants of increased expenditure (Rawat, 2024).

Despite the growing body of literature, existing COI studies in India exhibit considerable heterogeneity in methodologies, cost components, and reporting standards, thereby limiting comparability and generalizability (Kalra *et al.*, 2025; Butt, 2022; Chaudhary *et al.*, 2021). Furthermore, there is a paucity of context-specific, micro-costing studies in semi-urban populations, where healthcare access, affordability, and utilisation patterns differ significantly from urban settings.

Therefore, there is a critical need to conduct comprehensive cost-of-illness studies on T2DM using standardised methodologies to accurately estimate the economic burden and identify key cost drivers. Such evidence is essential for informing healthcare policy, optimising resource allocation, and developing cost-effective strategies to reduce the financial impact of diabetes and improve patient outcomes.

MATERIALS AND METHODS

Study Design and Setting

This was a prospective, observational, prevalence-based Cost-of-Illness (COI) study conducted across five private diabetic clinics in Suryapet, Telangana, after obtaining approval from the institutional ethics committee.

Study Population and Sampling

T2DM patients (age>30 years) who were diagnosed with T2DM and attending the participating clinics were enrolled in the study. A sample size of 100 consecutive consenting patients was enrolled using purposive sampling to ensure representation of patients with and without complications.

Inclusion and Exclusion Criteria

Inclusion: Diagnosed T2DM, age>30 years, on Treatment (OHGA±insulin), willing to give consent. Exclusion: Type 1 diabetes, gestational diabetes, patients unable to respond and without a reliable proxy, and those not on treatment.

Data Collection Tools

A structured questionnaire adapted from standard COI instruments was used to collect sociodemographic data, clinical history, healthcare utilisation, medication and investigation costs, travel and food expenses, and productivity losses. Hospital bills and pharmacy receipts were used to verify reported costs where available.

Costing Methodology

Costs were categorised as: direct medical (consultations, drugs, investigations, hospital stays), direct non-medical (transport, food, accommodation), indirect (productivity losses measured using the human capital approach), and intangible (quality-of-life losses assessed qualitatively). All costs were recorded in INR and converted to USD at a rate of 1 USD=86.95 INR (2025). A bottom-up micro-costing approach was employed to estimate patient care costs.

Data Analysis

Descriptive statistics (means, medians, standard deviations) summarised costs. Independent t-tests were used to compare mean costs between groups. A multiple linear regression model was constructed to identify predictors of total annual cost, including age, gender, duration of diabetes, presence of complications (yes/no), treatment type (OHGA vs OHGA+Insulin), hospitalisation, and socioeconomic status. Significance was set at $p<0.05$.

RESULTS

Baseline Characteristics of Study Subjects

Hundred patients were enrolled; baseline demographic and clinical characteristics are presented in Table 1. The mean age of enrolled patients was 56.2 years. The majority were from lower-middle socioeconomic backgrounds, and 72% had no formal health insurance. The mean duration of diabetes was 10.1 years; those with complications had longer mean disease duration. The data were presented in Table 1.

The age distribution of enrolled patients is shown in Figure 1.

Cost Findings (Monthly and Annual Estimates)

Monthly costs per patient were calculated. The mean cost per patient is Rs. 3701.58 with complications and Rs. 2317.08 without complications. All data are presented in Table 2.

Annual Costs of T2DM patients with and without complications

The annual costs for T2DM patients, with or without complications, were calculated. The annual costs for patients with complications are Rs. 44417=68, and without complications, are Rs. 27,804=96. The data is presented in Table 3.

Table 1: Demographic and Clinical Characteristics of Study Participants (n=100).

Characteristic	With complications (n=63)	Without complications (n=37)	Total (n=100)
Age (mean±SD)	58.1±9.6	52.4±10.2	56.2±10.4
Gender (M/F)	30/33	20/17	50/50
Duration of diabetes (years)	12.4±6.2	7.1±4.3	10.1±5.9
On Insulin therapy	36	0	36
Hypertension	28	6	34
Nephropathy	12	0	12
Retinopathy	9	0	9
Neuropathy	13	0	13

Table 2: Monthly Cost per Patient (INR).

Cost Component	With complications (Mean INR)	Without complications (Mean INR)	Total (Mean INR)
Consultation fees	380.95	337.83	360.00
Laboratory charges	569.84	327.03	480.00
Medication charges	1629.38	679.32	1200.00
Travel	282.53	191.89	240.00
Food	243.65	127.02	200.00
Loss of wages	363.49	408.10	380.00
Intangible (QoL) - proxy	231.74	245.9	240.00
Total monthly cost (INR)	3701.58	2317.08	3000.00

Age Distribution of Patients

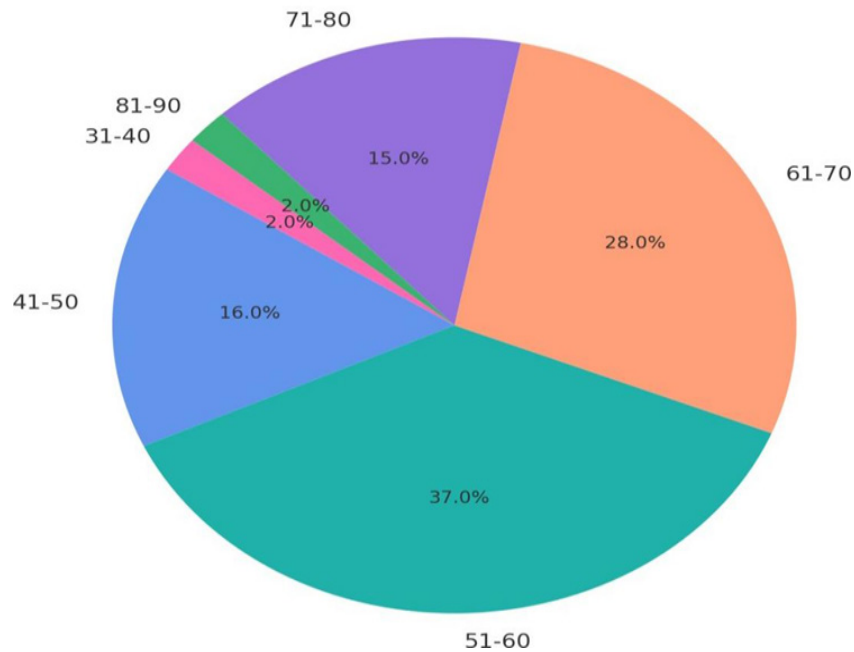


Figure 1: Age distribution of the participants.

Table 3: Annual Costs per Patient (INR and USD).

Component	With complications (INR)	Without complications (INR)	With complications (USD)	Without complications (USD)
Consultation	4571.4	4053.96	52.56	46.56
Laboratory	6838.08	3924.24	78.60	45.12
Medication	19552.56	8151.84	225.00	93.72
Travel	3390.36	2302.68	39.00	26.52
Food	2923.80	1524.24	33.60	17.52
Loss of wages	4361.88	4897.20	50.16	56.28
Intangible	2780.88	2950.8	32.04	33.96
Total annual cost	44417.68	27804.96	510.96	319.68

Annual Costs per Patient (INR and USD).

Table 4: Regression Analysis: Predictors of Total Annual Cost.

Variable	Coefficient (β)	Std. Error	t-value	p-value
Intercept	10234.5	1200.3	8.52	<0.001
Age (years)	42.1	17.9	2.35	0.02
Gender (M)	318.6	450.2	0.71	0.48
Duration (years)	198.4	67.5	2.94	0.004
Complications (yes)	15218.3	1389.2	10.95	<0.001
Insulin therapy (yes)	5612.8	1020.5	5.50	<0.001
Hospitalisation (yes)	8763.4	1450.1	6.05	<0.001
Socioeconomic (low vs high)	2123.5	980.4	2.17	0.03

Regression Analysis: Predictors of Total Annual Cost

A multiple linear regression model was constructed with total annual cost (INR) as the dependent variable. Independent variables included age, gender (male=1/female=0), duration of diabetes (years), presence of complications (yes=1/no=0), treatment type (insulin usage yes=1/no=0), history of hospitalisation in the past year (yes=1/no=0), and socioeconomic status (categorical). The model explained a substantial proportion of variance (Adjusted $R^2=0.49$). Key findings are presented in Table 4.

DISCUSSION

This study estimates the economic burden of T2DM at the district level in a semi-urban setting. Cost-of-Illness (COI) analysis helps quantify the financial impact of chronic diseases by estimating direct and indirect costs incurred by patients. The total treatment cost was primarily driven by medication expenses, laboratory investigations, and productivity loss, highlighting the substantial economic burden faced by diabetic patients. The annual mean cost for patients with complications (US\$510.96) was substantially higher than for those without complications (US\$319.68), consistent with prior studies from India and other middle-income countries. The regression analysis highlights complications, insulin usage and hospitalisation as significant

predictors of higher costs. Medication costs comprised the largest share of direct medical costs; however, laboratory investigations and hospitalisation costs were also important contributors. These findings suggest that interventions that reduce the incidence of complications (e.g., improved glycaemic control, screening programs) could yield significant economic benefits. Furthermore, policies to reduce drug prices, increase access to affordable generics and subsidise essential laboratory tests could decrease out-of-pocket spending. The analysis also identified socioeconomic vulnerability: individuals from lower socioeconomic strata exhibited higher proportional burdens relative to income, reflecting inequities in healthcare financing. Low insurance coverage (approx. 28%) further exacerbates financial risk. Similar findings were reported by the American Diabetes Association, which estimated that the annual medical expenditure for diabetic patients is approximately 2-3 times higher than for non-diabetic individuals (International Diabetes Federation, 2021; American Diabetes Association, 2023).

A study conducted by Bansal *et al.*, in 2025 in north India observed the household economic consequences of T2DM. The total annual cost of managing T2DM was estimated at ₹17,113, with out-of-pocket spending of ₹10,424. Direct medical costs formed the largest share of overall expenditure, and drug costs were the dominant component within that category. The study

also showed an important equity dimension: 10.14% of patients experienced catastrophic health expenditure, 19.59% were pushed into impoverishment, and the poverty gap worsened after diabetes-related spending (Bansal *et al.*, 2025). The study findings reiterate that diabetes is not only a clinical problem but also a driver of household financial stress, especially in settings with substantial out-of-pocket payments.

Another community-based study in the slum areas of Agra assessed the economic burden of diabetes. Among 360 known diabetic patients, nearly 96% had type 2 diabetes and 98% incurred out-of-pocket expenditure. The monthly median total OOPE was ₹2,200, comprising ₹1,500 in direct and ₹505 in indirect expenditure. Medicines, consultation, investigations, and expenses related to complications contributed heavily to direct costs (Prathyusha *et al.*, 2025)

The DEDICOM-II survey was a community-based cluster design and estimated the annual direct out-of-pocket cost of ambulatory diabetes care in Delhi at about ₹8,074.8 per patient, corresponding to 3.6% of yearly family income (Rawat *et al.*, 2024). In another study conducted in Southern India, the annual expenditure for T2DM care was estimated at ₹5,041, rising to ₹9,133 among those with comorbidities. The study identified medication and hospitalisation as the major direct cost drivers, and multivariable analysis found that older age, male gender, higher socioeconomic status, higher literacy, and disease duration independently predicted higher expenditure (Olickal *et al.*, 2023). A Pan-India study reported an average expenditure of ₹1,098.25 per person per month, translating to ₹13,179 annually. (Nagarathna *et al.*, 2021) Another study assessing the costs of seeking health behaviour found that about 73.5% of participants reported spending ₹10,001-20,000 annually on diabetes care, and 39.8% devoted 0-10% of their monthly income to healthcare expenses.

Butt *et al.* observed that the economic burden in a lower-middle-income setting is useful for international comparison because it evaluates the economic burden of T2DM in a context structurally like many South Asian settings (Kalra *et al.*, 2025). The article's core contribution is demonstrating that T2DM generates substantial direct and indirect costs even where average health spending is relatively low, and that a formal cost-of-illness framework can identify the main cost drivers. It helps reinforce the broader argument that diabetes is not only a high-income-country expenditure problem; it is a major financial burden in resource-constrained settings as well. Most of the study's findings corroborate our findings (Butt, 2024; Chaudhary *et al.*, 2021; Oberoi *et al.*, 2020; Kurniawan *et al.*, 2022).

The growing economic burden of Type 2 Diabetes Mellitus (T2DM) necessitates the implementation of cost-effective healthcare strategies, among which clinical pharmacist-led interventions have emerged as promising. Recent literature (2020-2025) consistently demonstrates the clinical pharmacist's role in cost reduction by

improving clinical outcomes, enhancing medication adherence, and preventing complications. A 2025 cost-effectiveness study demonstrated that structured pharmacist interventions significantly reduced HbA1c levels and cardiovascular risk, leading to lower long-term healthcare costs and improved quality-adjusted life outcomes. Similarly, quasi-experimental and randomised studies have shown that pharmacist-managed diabetes programs reduce medication-related costs and overall treatment expenses by optimising therapy and preventing unnecessary drug use (Pousinho *et al.*, 2016).

CONCLUSION

The Cost of Illness associated with T2DM in Suryapet is substantial and increases markedly with the presence of complications. Our findings underscore the pressing need for preventive strategies, greater financial protection, and policies to ensure affordable access to medications and diagnostics.

Mitigating the economic burden will require coordination across public health programs, insurance schemes, and community-level interventions.

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ABBREVIATIONS

T2DM: Type 2 Diabetes Mellitus; **COI:** Cost of Illness; **INR:** Indian Rupee; **USD:** United States Dollar; **OHGA:** Oral Hypoglycemic Agents; **QoL:** Quality of Life; **SD:** Standard Deviation; **R²:** Coefficient of Determination; **OOPE:** Out-of-Pocket Expenditure; **IDF:** International Diabetes Federation.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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