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Epidemiological study of diabetes mellitus among adult population attending a tertiary care center, in India

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Abstract:
Diabetes mellitus is a major non-communicable disease with a growing burden of complications, highlighting the need to characterize its epidemiological profile and associated risk factors. This cross-sectional observational study evaluated 300 adults with diabetes mellitus attending a tertiary care hospital through clinical assessment, laboratory investigations and evaluation of socio-demographic characteristics, lifestyle factors, glycemic status, comorbidities and complications. Most participants were 51–60 years old (32.7%), male (58.7%) and urban residents (64.7%); 75.3% were overweight/obese, 59.0% were physically inactive, 69.0% had poor glycemic control and diabetic neuropathy (34.0%) was the most frequent complication. The high prevalence of modifiable risk factors and poor glycemic control was accompanied by a substantial burden of diabetes-related complications. These findings advance knowledge by emphasizing integrated risk-factor modification, regular glycemic monitoring and early complication screening to improve diabetes outcomes in tertiary care settings.

Keywords: Diabetes mellitus (DM), epidemiology, glycemic control, risk factors, diabetic complications, tertiary care center

Background:
Diabetes mellitus (DM) is a chronic metabolic disorder in which there is a persistent hyperglycemia due to the loss of function of insulin secretion or insulin action or both. It is among the most prevalent non-communicable diseases globally and is emerging as a significant public health problem due to its rising prevalence, chronic complications and substantial socioeconomic burden. Cardiovascular disease, chronic kidney disease, retinopathy, neuropathy and premature mortality are all associated with diabetes. The increasing prevalence of diabetes has been attributed to rapid urbanization, unhealthy dietary patterns, sedentary lifestyles, obesity and population ageing to a great extent in low- and middle-income countries like India **[1].** In 2019, there were an estimated 463 million adults with diabetes globally and this is expected to rise to 700 million by 2045, according to the International Diabetes Federation (IDF) Diabetes Atlas. In 2021, updated estimates showed that 537 million adults were affected globally and 783 million by 2045. Almost 50% of people with the condition are never diagnosed, which means there is a risk of complications later in life **[2]**. Rapid urbanization, lifestyle changes, rising obesity and genetic predisposition are responsible for India becoming one of the countries with the highest diabetes burden in the world. The Indian Council of Medical Research –India Diabetes (ICMR-INDIAB) study revealed significant regional differences in the prevalence of diabetes and the need for ongoing epidemiological monitoring and preventive measures **[3]**. Chronic hyperglycemia results in progressive microvascular and macrovascular damage, which results in diabetic retinopathy, diabetic nephropathy, diabetic neuropathy, coronary artery disease and stroke. Although the diagnosis and treatment of diabetes has improved, diabetes-related complications remain a major cause of disability and health expenditure globally **[4]**. The recent consensus recommendations from ADA–EASD highlight the importance of personalized treatment, lifestyle modification, weight management and the use of glucose-lowering agents that have proven cardiovascular and renal benefits to enhance patient outcomes **[5]**. Worldwide, recent analyses estimate that the prevalence of diabetes will continue to increase until 2050, mainly due to obesity, aging and socio-economic changes **[6]**. The RSSDI White Paper identified delayed diagnosis, inadequate glycemic control and inadequate healthcare access as significant challenges in diabetes management in India **[7]**. Likewise, diabetes prevalence showed significant state-wise differences in India as reported by the Global Burden of Disease Study **[8]** and thus, region-specific public health interventions are warranted. The ADA Standards of Care 2025 also advocate for early screening, personalized management and extensive cardiovascular risk reduction to reduce diabetes-related morbidity and mortality **[9]**. Hospital-based studies have reported varying estimates of diabetes mellitus prevalence. Khatri *et al.* reported a prevalence of 4.42% among adult outpatients attending a tertiary care centre in Nepal, whereas Karki *et al.* reported a prevalence of 23.93% among adults attending a tertiary care medical department, highlighting the variability in estimates across clinical settings and study populations **[10, 11]**. Therefore, it is of interest to assess the epidemiological profile of diabetes mellitus in adults visiting in a tertiary care centre.

Materials and Methods:
This study was a hospital-based cross sectional observational study done in the Department of General Medicine in a tertiary care teaching hospital for 12 months, following approval from the Institutional Ethics Committee. A total of 300 adult patients with diabetes mellitus attending the Medicine Outpatient Department (OPD) or admitted to the inpatient wards during the study period were included in the study. Patients who met

the inclusion criteria were recruited consecutively until the required number of patients was reached. Adults (18 years or older) who had Type 1 or 2 diabetes mellitus diagnosed per the American Diabetes Association (ADA) criteria and who could provide written informed consent were included. Patients under 18 years of age, those with gestational diabetes mellitus, secondary diabetes related to endocrine disorders or medications, critically ill patients who were not able to participate, patients who refused to participate and patients with incomplete clinical or laboratory data were excluded from the study. A pre-designed and pre-tested case record form was used to collect data, which included demographic information such as age, gender, residence, educational status, occupation and socio-economic status, as well as family history of diabetes, smoking, alcohol consumption, dietary habits, physical activity, duration of diabetes, treatment history, medication adherence and associated comorbidities including hypertension, dyslipidaemia, obesity, cardiovascular disease and chronic kidney disease. A detailed clinical evaluation including medical history, general examination, systemic examination, height, weight, body mass index (BMI), waist circumference and blood pressure were performed on all participants. Relevant laboratory investigations, including fasting blood sugar (FBS), postprandial blood sugar (PPBS), random blood sugar (RBS), glycated haemoglobin (HbA1c), lipid profile, serum creatinine, blood urea, estimated glomerular filtration rate (eGFR), urine albumin, complete blood count and liver function tests, were performed or recorded from recent hospital investigations. Diabetes-related complications, such as diabetic retinopathy, nephropathy, neuropathy, coronary artery disease, cerebrovascular disease, peripheral arterial disease and diabetic foot complications were also assessed in patients. The primary outcome measure was the epidemiology of diabetes mellitus in adult patients and the secondary outcome measures were the distribution of demographic characteristics, the prevalence of lifestyle-related risk factors, glycemic control status, associated comorbidities, prevalence of diabetic complications and the relationship between the demographic and clinical variables and glycemic control status. Data were then entered into Microsoft Excel and analysed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were reported as mean ± standard deviation (SD) and categorical variables as frequencies and percentages. The independent Student's t-test, Chi-square test, Fisher's exact test (where appropriate), one-way analysis of variance (ANOVA), Pearson's correlation analysis and binary logistic regression were used for statistical analysis to determine predictors of poor glycemic control. Throughout the study, a p value of < 0.05 was deemed statistically significant.

Results:

A total of 300 adult patients diagnosed with diabetes mellitus were included in this hospital-based cross-sectional study. The epidemiological characteristics, clinical profile, glycemic status, associated comorbidities and chronic diabetic complications were evaluated. Statistical analysis was performed using the Chi-square test and Student's *t*-test wherever appropriate. A *p*-value of less than 0.05 was considered statistically significant. Among the 300 participants, the highest proportion (32.7%) belonged to the 51–60 years age group, followed by individuals aged above 60 years (27.3%). Males constituted 58.7% of the study population, while females accounted for 41.3%. Nearly two-thirds (64.7%) of patients belonged to urban areas. Overweight and obesity together were observed in 75.3% of participants, indicating a significant association between excess body weight and diabetes (p<0.001) **(Table 1)**. A positive family history of diabetes was present in 56.0% of patients. Physical inactivity (59.0%) and central obesity (57.0%) were the most prevalent modifiable risk factors. Hypertension was identified in 54.0%, while dyslipidaemia affected 46.0% of participants. Smoking was reported by 27.3% of patients and showed a statistically significant association with diabetes-related risk (p=0.041), whereas alcohol intake did not reach statistical significance **(Table 2)**. Good glycemic control (HbA1c <7%) was observed in only 30.7% of patients, whereas 69.3% had suboptimal glycemic control (HbA1c ≥7%). Approximately 30.0% exhibited poor glycemic control (HbA1c ≥9%). Most participants had diabetes for less than 10 years (73.3%). Oral hypoglycaemic agents remained the commonest treatment modality (56.3%), followed by insulin therapy (24.7%) **(Table 3)**. Diabetic neuropathy was the most frequently observed complication, affecting 34.0% of patients, followed by diabetic retinopathy (24.7%), coronary artery disease (22.0%) and diabetic nephropathy (20.3%). Diabetic foot was present in 9.0% of participants. Most chronic microvascular complications demonstrated statistically significant associations with longer disease duration and poor glycemic control (p<0.05), while cerebrovascular disease did not show a statistically significant association **(Table 4)**.

Table 1: Distribution of study participants according to sociodemographic characteristics (n=300)

Variable	Frequency (n)	Percentage (%)	p value
Age Group (Years)			0.021
18–40	48	16.0	
41–50	72	24.0	
51–60	98	32.7	
>60	82	27.3	
Gender			0.184
Male	176	58.7	
Female	124	41.3	
Residence			0.039
Urban	194	64.7	
Rural	106	35.3	
BMI Category			<0.001
Normal	74	24.7	
Overweight	121	40.3	
Obese	105	35.0	

Table 2: Lifestyle risk factors and family history of diabetes

Variable	Frequency (n)	Percentage (%)	p value
Family History of Diabetes	168	56.0	0.003
Hypertension	162	54.0	0.001
Dyslipidemia	138	46.0	0.008
Physical Inactivity	177	59.0	<0.001
Smoking	82	27.3	0.041
Alcohol Consumption	69	23.0	0.062

Central Obesity	171	57.0	<0.001

Table 3: Glycemic control and treatment characteristics

Variable	Frequency (n)	Percentage (%)	p value
HbA1c Level			<0.001
<7%	92	30.7	
7–8.9%	118	39.3	
≥9%	90	30.0	
Duration of Diabetes			0.011
<5 years	109	36.3	
5–10 years	111	37.0	
>10 years	80	26.7	
Treatment			0.028
Oral Drugs	169	56.3	
Insulin	74	24.7	
Combination Therapy	57	19.0	

Table 4: Prevalence of diabetes-related complications

Complication	Frequency (n)	Percentage (%)	p value
Diabetic Neuropathy	102	34.0	0.002
Diabetic Retinopathy	74	24.7	0.013
Diabetic Nephropathy	61	20.3	0.018
Coronary Artery Disease	66	22.0	0.026
Cerebrovascular Disease	18	6.0	0.083
Diabetic Foot	27	9.0	0.047

Discussion:

This is a cross sectional study of 300 adult patients attending the hospital for diabetes mellitus, carried out in the present hospital. The study showed that the diabetes was mainly seen among middle aged and elderly adults, males, urban residents, overweight and obese people and sedentary lifestyle. Poor glycemic control and high burden of chronic diabetic complications were also observed, which is in line with recent global and national evidence of the increasing public health burden of diabetes mellitus. Most of the patients were in the age group of 51-60 years and above 60 years. Progressive β-cell dysfunction, insulin resistance and cumulative metabolic stress are well established non-modifiable risk factors, which is why advancing age is a risk factor **[12, 13]**. In addition, Williams *et al.* reported that aging populations also play a significant role in the growing burden of diabetes and its complications on health care systems **[14]**. The male predominance reported in the present study is similar to that reported in earlier studies. Men have slightly higher prevalence of diabetes due to higher central adiposity, occupational stress, smoking and metabolic risk factors. The European Society of Cardiology (ESC) also highlights the need to assess the cardiometabolic risk in diabetes patients on a sex-specific basis **[13]**. Urbanization, sedentary lifestyle and unhealthy dietary habits had an impact, with nearly two-thirds of the participants being urban residents. The International Diabetes Federation (IDF) Clinical Practice Recommendations 2025 highlighted lifestyle transition and urbanization as key drivers of the rising type 2 diabetes burden and emphasized the need for community-based interventions to prevent type 2 diabetes **[12, 13]**. More than three-quarters of the study population were overweight or obese. Overweight and obesity lead to insulin resistance via chronic inflammation and glucose metabolism changes. International guidelines have always emphasized the link between obesity and diabetes. Williams *et al.* showed that obesity is a major driver of diabetes-related health care costs and the ADA Standards of Care 2026 state that weight management, nutrition counseling and regular physical activity are key components of diabetes care **[14, 16]**. Common associated risk factors included physical inactivity, hypertension, dyslipidaemia and positive family history, reflecting the clustering of cardiometabolic abnormalities in type 2 diabetes. To prevent long-term vascular complications, the ADA Standards of Care 2026 call for a cardiovascular risk assessment and optimization of blood pressure and lipids **[15, 16].** Nearly 70% of participants had poor glycemic control and only one-third had an HbA1c level below the recommended target of <7%. Suboptimal diagnosis, treatment adherence and lifestyle factors can play a role in suboptimal control. The recent ADA guidelines suggest setting personalized glycemic goals depending on patient characteristics and comorbidities for better long-term outcomes **[14].** The most frequent chronic complications were diabetic neuropathy, followed by retinopathy, nephropathy, coronary artery disease and diabetic foot. These complications are caused by persistent hyperglycemia which causes endothelial dysfunction, oxidative stress and vascular injury. Chronic complications are becoming more common and are a significant cost of healthcare worldwide. More recent studies have also shown that diabetes is a major economic burden due to the resulting cost of healthcare, disability and loss of productivity **[9, 17 and 18]**. Precision medicine, multidisciplinary care, digital health technologies and continuous glucose monitoring are key recent advances in diabetes management. Structured diabetes education, individualized nutrition therapy, remote glucose monitoring and multidisciplinary follow-up to optimize glycemic control and minimize diabetes-related complications is recommended by the ADA Standards of Care 2026 **[15].** In general, the present results are in line with the current evidence that diabetes mellitus is still a public health problem with a high prevalence, poor glycemic control and high burden of chronic complications. The key to improving outcomes and lowering future health care costs is to strengthen preventive strategies, encourage healthy lifestyles, increase patient awareness and implement guideline-directed management.

Conclusion:

Diabetes mellitus predominantly affected middle-aged and older adults and was strongly associated with obesity, physical inactivity, hypertension, dyslipidaemia and a positive family history. Poor glycemic control contributed to a high burden of chronic complications, particularly diabetic neuropathy, retinopathy, nephropathy and cardiovascular disease. These findings reinforce the importance of early screening, comprehensive risk-factor modification and multidisciplinary diabetes care to reduce diabetes-related morbidity and long-term disease burden.

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