

# THE MAGNITUDE OF CHRONIC DIABETES COMPLICATIONS AND THEIR ASSOCIATED FACTORS AMONG DIABETIC PATIENTS ATTENDING A TERTIARY CARE HOSPITAL: A CROSS-SECTIONAL STUDY

*Original Research*

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## ABSTRACT

**Background:** Diabetes mellitus (DM) is a leading non-communicable disease worldwide, with Pakistan ranking third globally in terms of diabetes prevalence. Chronic complications of diabetes impose a significant burden on healthcare systems, leading to increased morbidity, healthcare costs, and reduced quality of life. Despite advancements in treatment, a substantial proportion of patients develop complications that could be mitigated through early diagnosis, lifestyle modifications, and adherence to treatment. Identifying risk factors and their association with complications is essential for developing targeted interventions to improve patient outcomes.

**Objective:** This study aims to assess the prevalence of chronic diabetes complications and identify key factors contributing to their development in patients attending a tertiary care hospital.

**Methods:** A cross-sectional study was conducted at Ayub Teaching Hospital, Abbottabad, from September to November 2024. A total of 196 clinically diagnosed type 2 diabetic patients were recruited using a non-probability convenience sampling technique. Data were collected through structured face-to-face interviews, and medical records were reviewed for diabetes-related complications. Statistical analyses were performed using SPSS-27, with associations evaluated through chi-square and logistic regression tests, considering a p-value <0.05 as statistically significant.

**Results:** The majority of participants (50.0%) were aged 41–60 years, with 55.6% being female. The most prevalent complications were diabetic eye disease (55.6%) and nephropathy (45.4%), followed by coronary artery disease (30.6%), neuropathy (28.6%), hypertension (28.6%), cerebrovascular accidents (27.0%), and diabetic foot disease (25.5%). A significant association was found between regular physical activity and reduced complication risk (p=0.052). Duration of diabetes showed a strong correlation with coronary artery disease, diabetic foot, and diabetic eye disease (p=0.000), and nephropathy (p=0.002). A weak association was observed between BMI and coronary artery disease (p=0.050), while compliance with medications showed a notable association with coronary artery disease (p=0.066).

**Conclusion:** Age, lifestyle factors, and medication adherence significantly influence the development of chronic diabetes complications. Collaborative efforts between healthcare providers and policymakers are essential to enhance early detection, patient education, and comprehensive diabetes management strategies to reduce complications and improve health outcomes.

**Keywords:** Chronic complications, Diabetes mellitus, Diabetic nephropathy, Diabetic retinopathy, Medication adherence, Risk factors, Type 2 diabetes.

## INTRODUCTION

Chronic diabetes mellitus (DM) is a metabolic disorder characterized by persistent hyperglycemia, resulting in long-term complications that significantly impact patients' quality of life and increase the burden on healthcare systems. It is one of the most prevalent non-communicable diseases globally, posing a serious threat to human health. Despite efforts to control its incidence, diabetes prevalence continues to rise, particularly in developing and industrialized nations. According to the International Diabetes Federation (IDF), an estimated 451 million adults worldwide had diabetes in 2017, and this number is projected to rise to 693 million by 2045 if effective preventive measures are not implemented (1,2). In Pakistan, diabetes has reached alarming proportions, with one in four individuals affected, placing the country third globally in terms of the number of diabetic patients, following China and India (3). The increasing prevalence of diabetes is accompanied by a growing incidence of chronic complications, leading to heightened healthcare demands, financial burdens, and reduced life expectancy (4). Diabetes complications are broadly categorized into vascular and nonvascular types. Vascular complications include microvascular issues such as nephropathy, retinopathy, and neuropathy, while macrovascular complications encompass coronary artery disease, cerebrovascular disease, and peripheral vascular disease. Nonvascular complications include gastroparesis, sexual dysfunction, and various dermatological conditions (5). Studies indicate that a significant proportion of diabetic patients develop chronic complications, with hypertension being the most prevalent (96%), followed by peripheral neuropathy (46%), neuropathy (30%), and neuropathy-related impotence (7%). Additionally, diabetic foot ulcers (39%) and cardiovascular diseases (21%) are among the leading causes of hospital admissions for diabetic patients. Diabetes is also a major contributor to visual impairment, with 2.6% of global blindness cases attributed to diabetic retinopathy. Moreover, individuals with diabetes face an increased risk of early-onset glaucoma, cataracts, and other ocular disorders (6).

Given the substantial morbidity and mortality associated with diabetes, understanding the factors influencing disease progression and complications is essential. Various modifiable and non-modifiable factors, including age, socioeconomic status, adherence to treatment, blood pressure, duration of diabetes, body mass index (BMI), smoking, physical activity, diet, and family history, contribute to disease outcomes. Poor diabetes awareness, inadequate medication adherence, and suboptimal self-care behaviors exacerbate hyperglycemia and increase complication risks. Effective diabetes management requires lifestyle modifications, medication adherence, and patient education to improve glycemic control (7). Evidence suggests that individuals who are well-informed and actively engaged in their diabetes management achieve better outcomes than those with limited knowledge and motivation (8). A well-structured health education program tailored to individual needs can enhance adherence to treatment regimens and mitigate disease complications (9). Despite the growing burden of diabetes in Pakistan, limited studies comprehensively assess the magnitude and associated factors of chronic diabetes complications among patients attending tertiary care hospitals. This study aims to bridge this knowledge gap by systematically evaluating the prevalence of diabetes complications and identifying key predictors that contribute to disease progression. Understanding these factors will help develop targeted clinical interventions and preventive strategies, ultimately reducing diabetes-related morbidity and mortality. Furthermore, the findings of this study will inform policymakers in designing effective public health initiatives to mitigate the impact of diabetes in Pakistan.

## METHODS

This cross-sectional study was conducted over three months, from September to November, to assess the magnitude of chronic diabetes complications and their associated factors among patients with type 2 diabetes mellitus (T2DM) attending a tertiary care hospital. A total of 196 participants were recruited using a non-probability convenience sampling method. Data were collected through an interview-based structured questionnaire designed to obtain comprehensive information on patient demographics, diabetes history, adherence to treatment, lifestyle factors, and the presence of diabetes-related complications. The questionnaire included both closed and open-ended questions to ensure a thorough assessment of relevant variables. The study population comprised patients clinically diagnosed with T2DM who visited the hospital for diabetes-related concerns during the study period. Only individuals who provided informed consent and were capable of participating in the interview were included. Patients without a confirmed diagnosis of T2DM, those diagnosed with type 1 diabetes mellitus, pregnant women, critically ill patients, and individuals unable to provide informed consent due to cognitive impairment or a Glasgow Coma Scale (GCS) score of less than 15 were excluded to maintain data reliability and relevance.

Ethical approval for the study was obtained from the Institutional Review Board (IRB) or the hospital's ethical committee. Informed consent was obtained from all participants after explaining the study objectives, procedures, potential risks, and benefits. Confidentiality and anonymity of the participants were ensured, and they retained the right to withdraw from the study at any stage without any consequences. Data were analyzed using appropriate statistical methods to identify the prevalence of diabetes complications and associated risk factors. Descriptive statistics were employed to summarize demographic and clinical characteristics, while inferential statistics were used to explore associations between variables. Continuous variables were expressed as means and standard deviations, whereas categorical variables were presented as frequencies and percentages. Statistical tests such as chi-square tests, independent t-tests, and logistic regression analyses were applied as needed to examine relationships between independent variables and diabetes complications. A p-value of  $<0.05$  was considered statistically significant.

## RESULTS

The study included 196 patients with type 2 diabetes mellitus, of whom 50.0% were aged between 41 and 60 years, 17.3% were aged  $\leq 40$  years, and 32.7% were older than 61 years. The majority of participants were female (55.6%), while males constituted 44.4% of the sample. Most patients were married (91.8%), and a significant proportion (57.1%) had no formal education, with only 8.2% having attained higher secondary education. Employment status revealed that 74.5% were unemployed, while 25.5% were employed. Among the diabetic complications assessed, the most frequently reported was diabetic eye disease, affecting 55.6% of the participants. Nephropathy was present in 45.4% of patients, while coronary heart disease was observed in 30.6%. Neuropathy and hypertension each affected 28.6% of patients, while cerebrovascular accidents were reported in 27.0%. Diabetic foot was the least reported complication, affecting 25.5% of patients. A significant association was found between diabetes and nephropathy ( $p=0.027$ ).

Regarding risk factors for diabetes complications, 70.9% of patients had a family history of diabetes, 42.9% engaged in regular physical activity for at least 30 minutes, and 16.8% had a history of smoking. The majority (93.9%) were taking anti-diabetic medications, while 37.2% used antiplatelet drugs and 27.0% were on lipid-lowering medications. Only 28.6% of patients reported having knowledge of diabetes complications. Regular physical activity showed a borderline significant association with the development of complications ( $p=0.052$ ). The duration of diabetes was significantly associated with the presence of certain complications. Patients who had diabetes for more than 15 years were more likely to develop coronary artery disease (10.2%), nephropathy (12.2%), diabetic foot disease (10.2%), and diabetic eye disease (14.8%), with p-values of  $<0.05$ . However, no significant associations were found between disease duration and hypertension ( $p=0.801$ ), cerebrovascular accidents ( $p=0.256$ ), or neuropathy ( $p=0.801$ ).

A weak association was observed between body mass index (BMI) and coronary artery disease ( $p=0.050$ ), while other complications, including hypertension, cerebrovascular disease, neuropathy, nephropathy, diabetic foot, and diabetic eye disease, did not show statistically significant associations with BMI ( $p>0.05$ ). Among individuals with BMI  $>25$  kg/m<sup>2</sup>, 25.0% had hypertension, 24.5% had cerebrovascular disease, and 29.1% had coronary artery disease. Medication compliance was assessed in relation to diabetes complications, revealing that 66.8% of patients adhered to regular medication use. Despite adherence, 19.4% developed hypertension, 14.3% had cerebrovascular disease, and 22.9% had coronary artery disease. A significant association was observed between cerebrovascular accidents and irregular medication adherence ( $p=0.011$ ), while compliance showed no significant impact on other complications ( $p>0.05$ ).

**Table 1: Sociodemographic data**

Variable	Category	Frequency	Percent
Patient Age	$\leq 40$	34	17.3
	41–60	98	50.0
	$> 61$	64	32.7
Patient Gender	Male	87	44.4
	Female	109	55.6

Variable	Category	Frequency	Percent
<b>Marital Status</b>	Single	16	8.2
	Married	180	91.8
<b>Education</b>	Not formally educated	112	57.1
	Primary education	18	9.2
	Secondary education	50	25.5
	Higher secondary education	16	8.2
<b>Occupation</b>	Employed	50	25.5
	Unemployed	146	74.5

**Table 2: Complications of diabetes**

Complications	YES		No		p-value
	Frequencies (N)	Percentage (%)	Frequencies (N)	Percentage (%)	
CHD	60	30.6	136	69.4	0.373
Nephropathy	89	45.4	107	54.6	0.027
Diabetic foot	50	25.5	146	74.5	0.984
Diabetic eye	109	55.6	87	44.4	0.437
Neuropathy	56	28.6	140	71.4	0.186
Hypertension	56	28.6	140	71.4	0.186
CVA	53	27.0	143	73.0	0.283

**Table 3: Risk factors for development of complications**

Risk Factors	YES Frequencies (%age)	NO Frequencies (%age)	P-value
Exercise regularly or walk for 30 minutes	84 (42.9)	112 (57.1)	0.052
Family history of diabetes	139 (70.9)	57 (29.1)	0.655
Taking anti-diabetics currently	184 (93.9)	12 (6.1)	0.183
Anti-platelet drugs	73 (37.2)	123 (62.8)	0.417
Take medicine regularly	131 (66.8)	65 (33.2)	0.737
Lipid lowering drugs	53 (27)	143 (73)	0.329
Smoking	33 (16.8)	163 (83.2)	0.342
Any idea about the complications of diabetes	56 (28.6)	140 (71.4)	0.444

**Table 4: Association between Duration of diabetes and complication**

Complication	Outcome	<5 years	6-10 years	11-15 years	>15 years	Total	p-value
Hypertension	Yes	19 (9.69%)	17 (8.67%)	11 (5.61%)	9 (4.59%)	56	0.801
	No	44 (22.45%)	49 (25.00%)	21 (10.71%)	26 (13.27%)	140	
CVA	Yes	14 (7.14%)	15 (7.65%)	11 (5.61%)	13 (6.63%)	53	0.256
	No	49 (25.00%)	51 (26.02%)	21 (10.71%)	22 (11.22%)	143	
CAD	Yes	8 (4.08%)	20 (10.20%)	11 (5.61%)	20 (10.20%)	59	0
	No	55 (28.06%)	46 (23.47%)	21 (10.71%)	15 (7.65%)	137	
Neuropathy	Yes	19 (9.69%)	17 (8.67%)	9 (4.59%)	9 (4.59%)	56	0.801
	No	44 (22.45%)	49 (25.00%)	26 (13.27%)	26 (13.27%)	140	
Nephropathy	Yes	20 (10.20%)	27 (13.77%)	18 (9.18%)	24 (12.24%)	89	0.002
	No	43 (21.94%)	39 (19.90%)	14 (7.14%)	11 (5.61%)	107	
Diabetic Foot	Yes	8 (4.08%)	10 (5.10%)	12 (6.12%)	20 (10.20%)	50	0
	No	55 (28.06%)	56 (28.57%)	20 (10.20%)	15 (7.65%)	146	
Diabetic Eye	Yes	19 (9.69%)	37 (18.88%)	24 (12.24%)	29 (14.80%)	109	0
	No	44 (22.45%)	29 (14.80%)	8 (4.08%)	6 (3.06%)	87	

**Table 5: Association between BMI and complications of diabetes**

Complication	Outcome	<25kg/m <sup>2</sup>	>25kg/m <sup>2</sup>	Total	p-value
Hypertension	Yes	7 (3.57%)	49 (25.00%)	56	0.401
	No	12 (6.12%)	128 (65.31%)	140	
CVA	Yes	5 (2.55%)	48 (24.49%)	53	0.94
	No	14 (7.14%)	129 (65.82%)	143	
CAD	Yes	2 (1.02%)	57 (29.08%)	59	0.05
	No	17 (8.67%)	120 (61.22%)	137	
Neuropathy	Yes	7 (3.57%)	49 (25.00%)	56	0.401
	No	12 (6.12%)	128 (65.31%)	140	
Nephropathy	Yes	7 (3.57%)	82 (41.84%)	89	0.43
	No	12 (6.12%)	95 (48.47%)	107	
Diabetic Foot	Yes	12 (6.12%)	97 (49.49%)	109	0.486
	No	7 (3.57%)	80 (40.82%)	87	
Diabetic Eye	Yes	5 (2.55%)	45 (22.96%)	50	0.932
	No	14 (7.14%)	132 (67.35%)	146	

**Table 6: Association between Compliance with medicines and complications of diabetes**

Complication	Outcome	Yes (Takes Medicine)	No (Doesn't Take Medicine)	Total	p-value
Hypertension	Yes	38 (19.39%)	18 (9.18%)	56	0.848
	No	93 (47.45%)	47 (23.98%)	140	
CVA	Yes	28 (14.29%)	25 (12.76%)	53	0.011
	No	103 (52.55%)	40 (20.41%)	143	
CAD	Yes	45 (22.96%)	14 (7.14%)	59	0.066
	No	86 (43.88%)	51 (26.02%)	137	
Neuropathy	Yes	38 (19.39%)	18 (9.18%)	56	0.848
	No	93 (47.45%)	47 (23.98%)	140	
Nephropathy	Yes	57 (29.08%)	32 (16.33%)	89	0.449
	No	74 (37.76%)	33 (16.84%)	107	
Diabetic Foot	Yes	71 (36.22%)	38 (19.39%)	109	0.572
	No	60 (30.61%)	27 (13.78%)	87	
Diabetic Eye	Yes	31 (15.82%)	19 (9.69%)	50	0.4
	No	100 (51.02%)	46 (23.47%)	146	

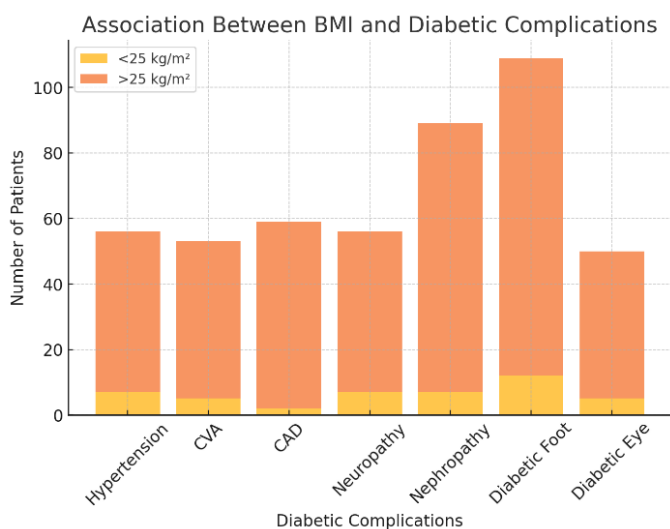


Figure 2 Association Between BMI & Diabetic Complications

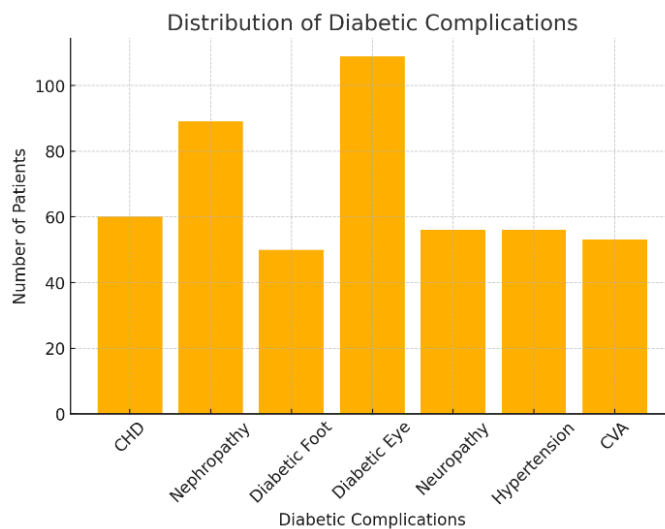


Figure 1 Distribution of Diabetic Complications

## DISCUSSION

The study provides a comprehensive analysis of chronic diabetic complications, their prevalence, and associated determinants in patients attending a tertiary care hospital. The findings highlight the considerable burden of diabetes-related complications, with diabetic eye disease being the most prevalent (55.6%), followed by nephropathy (45.4%), coronary artery disease (30.6%), neuropathy (28.6%), hypertension (28.6%), cerebrovascular accidents (27%), and diabetic foot disease (25.5%). These findings align with previous studies conducted in similar populations, emphasizing the widespread impact of diabetes complications on patient morbidity and healthcare burden (10, 11). The results reinforce the need for more comprehensive diabetes management strategies that extend beyond pharmacological interventions to include lifestyle modifications, regular monitoring, and patient education. Sociodemographic analysis

revealed that the majority of patients were between 41 and 60 years of age, with a higher prevalence among females (55.6%). The increased susceptibility of this age group to complications can be attributed to prolonged exposure to hyperglycemia and metabolic disturbances, which accelerate the progression of diabetic complications over time (12). The higher prevalence among females may be influenced by gender-related differences in risk factors, healthcare access, and hormonal variations that contribute to metabolic dysregulation. Additionally, a significant proportion of the participants had low educational attainment (57.1%), limiting their ability to comprehend diabetes management principles, which may have contributed to inadequate disease control. The high rate of unemployment (74.5%) further restricted access to healthcare resources and adherence to treatment regimens, reinforcing the link between socioeconomic status and health outcomes (13, 14).

Several modifiable risk factors were found to play a role in the development of complications. A strong genetic predisposition was observed, with 70.9% of patients reporting a family history of diabetes. Regular physical activity, particularly 30-minute daily exercise or walking, showed a significant association with a lower risk of complications, underscoring the importance of lifestyle interventions in diabetes management (15). Despite 66.8% of patients adhering to regular medication use, complications persisted, indicating that pharmacological treatment alone is insufficient. Effective diabetes management requires a multifaceted approach, incorporating structured lifestyle modifications, routine monitoring, and patient education to improve long-term outcomes (16). Coronary artery disease exhibited a weak association with BMI, with a higher prevalence observed among individuals with BMI >25 kg/m<sup>2</sup>. However, other complications did not demonstrate a statistically significant relationship with BMI. These findings suggest that while obesity is a known risk factor for cardiovascular diseases, its impact on diabetes complications may be mediated through mechanisms such as insulin resistance, chronic inflammation, and metabolic dysfunction rather than direct causation (17, 18). Although medication adherence was relatively high, its effectiveness in preventing complications was limited. A notable association was observed between cerebrovascular disease and irregular medication adherence, highlighting the critical role of consistent treatment in reducing the risk of severe complications. However, the persistence of complications despite medication use suggests the involvement of other contributing factors, including genetic predisposition, lifestyle behaviors, and delayed disease detection (19). A comprehensive diabetes management plan should integrate pharmacological therapy with structured lifestyle interventions and continuous patient education to achieve optimal glycemic control and minimize complications.

The study has several strengths, including its structured assessment of multiple diabetes complications and their associated risk factors. The findings provide valuable insights into the prevalence of complications and highlight critical gaps in diabetes management, particularly in resource-limited settings. However, certain limitations must be acknowledged. The cross-sectional nature of the study restricts the ability to establish causal relationships between risk factors and complications. The reliance on a single tertiary care hospital limits the generalizability of findings to broader populations, as hospital-based studies may overrepresent individuals with more severe disease presentations. Additionally, the use of self-reported data introduces the possibility of recall bias, which may affect the accuracy of reported medication adherence and lifestyle behaviors. Future studies should employ longitudinal designs to establish causal relationships between risk factors and complication development. Larger, multicenter studies with diverse populations would enhance the generalizability of findings and provide a more comprehensive understanding of diabetes complications. Further research should also explore the effectiveness of integrated diabetes care models that combine pharmacological treatment with lifestyle interventions and patient-centered education to improve long-term outcomes (20).

## CONCLUSION

This study highlights the substantial burden of chronic diabetes complications among patients attending a tertiary care hospital, emphasizing the critical role of sociodemographic factors, family history, lifestyle choices, and medication adherence in disease progression. The findings reinforce the need for early diagnosis, proactive management, and a comprehensive approach to diabetes care that extends beyond pharmacological treatment. Integrating lifestyle modifications, structured patient education, and routine monitoring can significantly reduce the risk of complications and improve overall patient outcomes. Strengthening diabetes awareness programs and ensuring accessible healthcare services are essential steps toward minimizing the long-term impact of diabetes and enhancing the quality of life for affected individuals.

## AUTHOR CONTRIBUTIONS

Author	Contribution
Ali Mujtaba*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Muqadas Tariq	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Bushra Zafar	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Muhammad Attique Ur Rehman	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Naveed Ahmed	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Faheem Zaman	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Malik Ishfaq Ali	Contributed to study concept and Data collection Has given Final Approval of the version to be published
Ata Ur Rehman	Writing - Review & Editing, Assistance with Data Curation

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