Original Article

Complications in Diabetes: How They Relate to Diabetes Duration.

Abdullah Arshad[*1], Eisha Ghani[1]

*Corresponding Author
Email: invisiblemirror50000@gmail.com

Affiliations:
[1]Wah Medical College, Wah Cantt, Pakistan

Details:
1. Abdullah Arshad
MBBS, Senior House Officer (S.H.O)
POF Hospital Wah Cantt, Pakistan
2. Eisha Ghani
MBBS, Senior House Officer (S.H.O)
POF Hospital Wah Cantt, Pakistan

COPE | creative commons | LINK MEDICAL INTERFACE

ABSTRACT

Background: Diabetes Mellitus (DM) is a major global public health issue, particularly in developing countries, where it exacerbates economic strain and leads to severe complications affecting various organs. This study examines the relationship between the duration of DM and the incidence of complications among patients in Pakistan.

Objective: To investigate the correlation between the duration of Diabetes Mellitus and the prevalence of associated complications in a sample of Pakistani patients, aiming to inform preventive measures and management strategies.

Methods: This cross-sectional study was conducted at Wah Medical College, Wah Cantt, Pakistan with REC committee approval and adherence to the Declaration of Helsinki. The sample size of 137 patients was determined using the WHO sample size calculator. Participants were selected through non-probability consecutive sampling and included those diagnosed with Type 1 or Type 2 DM who visited the outpatient and inpatient departments. Pregnant women with gestational diabetes or pre-existing diabetes were excluded. Written informed consent was obtained from all participants. Data collection involved demographic information and comprehensive laboratory tests, including liver function tests, renal function tests, HbA1c levels, random and fasting blood sugar levels, serum electrolytes, and urine analysis for proteins and albumin. Complications were documented as microvascular and macrovascular. Statistical analysis was performed using SPSS version 23, employing descriptive statistics and inferential statistics such as Chi-squared tests and t-tests, with a significance level set at $p < 0.05$.

Results: The study included 137 patients, with 68.80% male and 32.20% female. 81.80% had diabetes for less than ten years, and 18.20% had it for more than ten years. Type 2 DM was predominant, affecting 97.64% of participants. The incidence of microalbuminuria was 15.10% in patients with less than ten years of diabetes and 48.38% in those with a longer duration. Proteinuria occurred in 20.14% of those with a shorter duration and 54.83% with a longer duration. Comorbidities were present in 25.89% of patients with less than ten years of diabetes and 61.29% in those with a longer duration. Symptoms related to DM were reported by 23.74% of patients with a shorter duration and 54.83% of those with a longer duration.

Conclusion: Longer durations of Diabetes Mellitus are associated with higher incidences of microalbuminuria, proteinuria, and other diabetes-related symptoms and comorbidities. These findings underscore the necessity for stringent glycemic control, effective blood pressure management, and comprehensive patient education to prevent the progression of complications. Enhanced diabetes care can significantly improve patient outcomes and reduce the healthcare burden of this chronic disease.

INTRODUCTION

Diabetes Mellitus (DM) stands as a significant global public health issue, particularly affecting developing countries where it exacerbates economic strain and leads to various serious complications. This chronic condition disrupts carbohydrate metabolism, resulting in consistently high blood sugar levels, and is primarily classified into Type 1 and Type 2 DM. Type 1 DM, prevalent among children, involves the autoimmune destruction of insulin-producing beta cells in the pancreas. In contrast, Type 2 DM, which is more common in adults, stems from insulin resistance and poor insulin action, particularly in muscle tissues (2, 3, 4). The growing prevalence of DM is alarming, with global estimates in 2019 suggesting that 463 million people live with the disease, predominantly Type 2 DM. This number reflects a significant increase, particularly noted in Pakistan where the prevalence escalated from 11.77% in 2016 to 26.7% in 2022, making it the third most prevalent country for diabetes globally, following China and India (2, 4, 6-8).

The burden of diabetes is acute in the developing world, affecting vital organs and leading to severe complications such as cardiovascular, renal, central nervous system, and

ocular diseases, as well as poor wound healing that may result in limb amputations (5, 6). The mortality rate associated with DM is also noteworthy. The World Health Organization reported that in 2019 alone, 1.5 million deaths were directly linked to diabetes complications, with Pakistan featuring prominently among countries with the highest diabetes-related mortality rates (9-12). Lifestyle factors such as sedentary behaviors and high-sugar diets, along with genetic predispositions, play significant roles in the prevalence of the disease in these regions.

Research, including a notable study from China, shows that cardiovascular issues are the most common complication of DM, followed by cerebrovascular accidents, neuropathy, nephropathy, ocular issues, and foot complications. This study aims to examine the relationship between the duration of DM and the incidence of these complications in the Pakistani population. Understanding this correlation is crucial for developing effective preventive measures and management plans to mitigate the adverse outcomes associated with prolonged exposure to this debilitating disease.

MATERIAL AND METHODS

This study was carried out at Wah Medical College, Wah Cantt, Pakistan, with the approval of the REC committee and in compliance with the ethical principles outlined in the Declaration of Helsinki for conducting medical research involving human subjects. The sample size was calculated using the WHO sample size calculator to ensure the study's statistical power (12).

A total of 137 patients were included in this study through non-probability consecutive sampling. Eligible participants were those diagnosed with Type 1 or Type 2 Diabetes Mellitus visiting the outpatient and inpatient departments of medicine within the study's timeframe. Pregnant women with gestational diabetes or pre-existing

diabetes were excluded. All participants provided written informed consent, verifying their voluntary involvement and comprehension of the study's purpose and procedures.

Data were collected on basic demographics and a series of comprehensive laboratory tests for each participant, including liver and renal function tests, glycosylated hemoglobin (HbA1c), random and fasting blood sugar levels, serum electrolytes, and urine protein and albumin analysis. Additionally, detailed records of diabetes-related microvascular and macrovascular complications were maintained (13).

The data analysis was performed using SPSS version 23. Descriptive statistics calculated means and standard deviations for quantitative variables and frequencies and percentages for qualitative variables. Inferential statistics, including Chi-squared tests for categorical data and t-tests for continuous data, were used to examine the relationships between diabetes duration and its complications. A p-value of less than 0.05 was deemed statistically significant, indicating notable differences or correlations. This methodological rigor ensures that the study's results are reliable and applicable to a broader diabetic population in similar contexts.

RESULTS

The age distribution of the study participants revealed that the largest age group was between 20 to 30 years, accounting for 40.9% of the total population. This was closely followed by the 30 to 40 years age group, which comprised 39.4% of the participants. The youngest group, aged 10 to 20 years, made up 10.2%, and the smallest group, aged 40 to 50 years, constituted 8.8% of the total sample (Table l). In examining the complications and comorbidities related to the duration of diabetes, a significant disparity was observed between those with diabetes for less than ten years and those with diabetes for ten or more years.
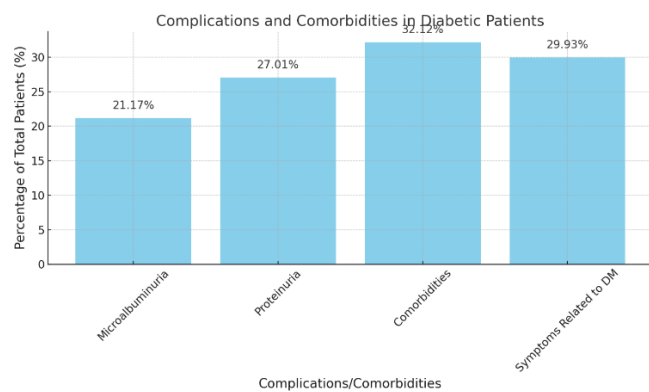
Table 1 Demographic and Clinical Summary

Characteristic	Value
Total Patients	137
Male (%)	68.80%
Female (%)	32.20%
Less than 10 years (%)	81.80%

More than 10 years (%)	18.20%
Type 2 DM (%)	97.64%
Type 1 DM (%)	2.46%

Table 2 Complications and Comorbidities Summary

Complication/Comorbidity	Total (%)
Microalbuminuria	29 (21.17%)
Proteinuria	37 (27.01%)
Comorbidities	44 (32.12%)
Symptoms Related to DM	41 (29.93%)

Figure 1 Complications and Comorbidities In Diabetic Patients

was present in 48.38% of those with a longer duration of the disease. Proteinuria was observed in 20.14% of patients with less than ten years of diabetes, compared to a striking 54.83% in those with a longer history of the disease. Comorbidities were also notably higher in the latter group, with 61.29% experiencing additional health issues, compared to 25.89% of those with a shorter duration of diabetes. Similarly, symptoms related to diabetes were reported by 54.83% of patients with a disease duration of ten or more years, in contrast to 23.74% of those with a shorter duration (Table III).

These findings highlight the substantial increase in complications and comorbidities associated with prolonged diabetes. The data clearly indicate that the longer a patient has diabetes, the more likely they are to develop serious complications such as microalbuminuria and proteinuria, as well as additional comorbidities and related symptoms. The high percentages of these conditions in patients with a longer duration of diabetes underscore the importance of early and effective management to mitigate the risk of such severe outcomes. The detailed analysis of the demographic and clinical characteristics, along with the observed complications, provides valuable insights into the progressive nature of diabetes and the critical need for ongoing monitoring and intervention (Table II, Table III).

DISCUSSION

The analysis of this study demonstrated a marked increase in complications among patients with a longer duration of Diabetes Mellitus (DM), including microalbuminuria, urinary proteinuria, diabetes-related symptoms, and comorbidities. A particularly noteworthy finding was the higher incidence of microalbuminuria in male patients compared to females. Chronic kidney disease, often initiated by microalbuminuria, is a critical concern as it is undetectable by routine dipstick tests and requires specific laboratory measurements of urine albumin levels for diagnosis (9). Microalbuminuria, defined as urinary albumin levels between 30-300 mg/dl in a 24-hour urine sample, serves as a precursor to diabetic nephropathy (11). The Albumin:Creatinine Ratio (ACR) has become the preferred diagnostic test for microalbuminuria, with specific reference ranges for males and females (12).

Upon diagnosing microalbuminuria, it was essential to initiate treatment with angiotensin-converting enzyme inhibitors (ACEi) or Angiotensin Receptor Blockers (ARBs) to mitigate the progression to overt nephropathy and eventual end-stage renal disease (13). Additionally, maintaining optimal glycemic levels, blood pressure, and serum cholesterol was crucial in preventing severe cardiovascular and renal outcomes in these patients (14). These findings align with other studies that highlight the broader implications of DM. For instance, research by Gul Khan et al. at the Armed Forces Institute of Cardiology, Rawalpindi, indicated an elevated mortality rate from myocardial infarction in diabetic patients due to

complications such as left ventricular failure, arrhythmias, and cardiogenic shock (15). Timmer JR et al. in Greece observed similar trends, underscoring the heightened risk of complications in diabetic patients compared to non-diabetics (16). Hafeez M et al. at Combined Military Hospital Multan reported nephropathy as a frequent complication, followed by retinopathy and macrovascular complications, although the rates of these conditions in Pakistani populations were relatively lower than those in other countries (17).

Further, studies such as Ali G et al.'s revealed that elevated uric acid levels in diabetic patients correlated with increased rates of complications, particularly nephropathy (18). Khan A et al. at the Armed Forces Institute of Ophthalmology in Rawalpindi found significantly higher rates of proliferative diabetic retinopathy among patients with a longer duration of DM (19). Similarly, research by Agarwal et al. and Azmat A et al. from KRL Hospital identified a correlation between higher HbA1c levels, longer disease duration, and increased rates of albuminuria and retinopathy (20, 21).

These comparisons underscored the critical need for early and effective management of DM to prevent severe complications. The study's findings reinforced the importance of controlling blood sugar levels and blood pressure, alongside educating patients on managing their condition. However, several limitations were noted. The cross-sectional nature of the research restricted the ability to establish causality between DM duration and the severity of complications. Future longitudinal studies could provide deeper insights into the progression of these complications over time. Expanding the demographic and geographic diversity of the study population could also enhance the generalizability of the findings.

Strengths of the study included a robust sample size and comprehensive data collection methods that ensured a detailed analysis of complications and comorbidities. However, the study's design and sampling method may have introduced selection bias, and the reliance on self-reported data could have led to information bias. Recommendations for practice included increased screening for microvascular complications and more rigorous public health initiatives to educate patients on the importance of lifestyle modifications in managing their condition.

CONCLUSION

In conclusion, the study indicated that longer durations of Diabetes Mellitus were associated with higher incidences of microalbuminuria, proteinuria, and other diabetes-related symptoms and comorbidities. These results underscored the critical need for stringent glycemic control, effective blood pressure management, and comprehensive patient education to mitigate the progression of complications. Enhancing these facets of diabetes care could significantly improve patient outcomes and reduce the healthcare burden associated with the chronic and progressive complications of diabetes. This approach not only supported individual patient health but also had broader implications for public health policy and resource allocation within healthcare systems.

REFERENCES

1.   Azeem S, Khan U, Liaquat A. The Increasing Rate of Diabetes in Pakistan: A Silent Killer. Ann Med Surg. 2022 Jul;79.

2.   Nasir M, Razzaque R, Afzal S. Epidemiology of Diabetes Mellitus, Pre-Diabetes, Undiagnosed and Uncontrolled Diabetes in Pakistan.

3.   Bakri HM, Alahmadi FM, Taiyeb AM, Khairallah HH, Andijani AM, Yaghmour KA. The Effect of Family Support, Knowledge, and Socioeconomic Status in Controlling Diabetes and Its Complications on the Patient. Middle East J Fam Med. 2022;7(10):89.

4.   IDF Diabetes Atlas. 9th edition [Internet]. [cited 2022   Apr   5].   Available   from: https://diabetesatlas.org/atlas/ninth-edition/.

5.   Nasir M, Razzaque R, Afzal S. Epidemiology of Diabetes Mellitus, Pre-Diabetes, Undiagnosed and Uncontrolled Diabetes in Pakistan.

6.   Meo SA, Zia I, Bukhari IA, Arain SA. Type 2 Diabetes Mellitus in Pakistan: Current Prevalence and

Future Forecast. J Pak Med Assoc. 2016 Dec 1;66(12):1637-42.

7. Yang JJ, Yu D, Wen W, Saito E, Rahman S, Shu XO, et al. Association of Diabetes with All-Cause and Cause-Specific Mortality in Asia: A Pooled Analysis of More than 1 Million Participants. JAMA Netw Open. 2019 Apr 5;2(4):e192696.

8. Liu Z, Fu C, Wang W, Xu B. Prevalence of Chronic Complications of Type 2 Diabetes Mellitus in Outpatients - A Cross-Sectional Hospital Based Survey in Urban China. Health Qual Life Outcomes. 2010 Dec;8(1):1-9.

9. Lam NN, Quinn RR, Clarke A, Al-Wahsh H, Knoll GA, Tibbles LA, et al. Progression of Kidney Disease in Kidney Transplant Recipients with a Failing Graft: A Matched Cohort Study. Can J Kidney Health Dis. 2023 May;10:20543581231177203.

10. Tutan D, Doğan M. Evaluation of Neutrophil/Lymphocyte Ratio, Low-Density Lipoprotein/Albumin Ratio, and Red Cell Distribution Width/Albumin Ratio in the Estimation of Proteinuria in Uncontrolled Diabetic Patients. Cureus. 2023 Aug 31;15(8).

11. Lu H, Cao Y, Duan P, Wu Y. Microalbumin and Diabetes Mellitus Type 2 (T2DM): A Mendelian Randomization Study.

12. Tao J, Sang D, Zhen L, Zhang X, Li Y, Wang G, et al. Elevated Urine Albumin-to-Creatinine Ratio Increases the Risk of New-Onset Heart Failure in Patients with Type 2 Diabetes. Cardiovasc Diabetol. 2023 Dec;22(1):1.

13. Pradana FJ, Tuba S. Novel Diabetic Nephropathy-Based Hypertension Treatment for Type-2 Diabetes Mellitus and CKD Patients: A Mini Review. J Med Health Stud. 2023 Aug 13;4(4):197-201.

14. Wang G, Liu X, Ying Z, Yang G, Chen Z, Liu Z, et al. Optimized Glycemic Control of Type 2 Diabetes with Reinforcement Learning: A Proof-of-Concept Trial. Nature Med. 2023 Sep 14:1-0.

15. Khan G, Khan IA, Khan FA, Farhan S, Kamran J, Janjua AF, et al. In-Hospital Early Complications in Diabetics Vs Non Diabetics with Acute ST Elevation Myocardial Infarction Age Group 30-70 Years. PAFMJ [Internet]. 2021 Jan 5 [cited 2023 Oct 31];70(Suppl-4):S576-80. Available from: https://www.pafmj.org/PAFMJ/article/view/6023

16. Timmer JR, Ottervanger JP, de Boer MJ, Boersma E, Grines CL, Westerhout CM, et al. Primary Percutaneous Coronary Intervention Compared with Fibrinolysis for Myocardial Infarction in Diabetes Mellitus: Results from the Primary Coronary Angioplasty vs Thrombolysis–2 Trial. Arch Intern Med. 2007 Jul 9;167(13):1353-9.

17. Hafeez M, Siddiqi AH, Ahmed I. Diabetes Mellitus in Soldiers, What's New: Diabetes Mellitus in Soldiers. PAFMJ [Internet]. 2018 Aug 31 [cited 2023 Oct 31];68(4):779-83. Available from: https://www.pafmj.org/PAFMJ/article/view/74

18. Ali G, Kamran MA, Amir M, Mumtaz B, Khan I, Tariq M. Frequency of Hyperuricemia in Type-2 Diabetes Mellitus and Its Relation with Diabetic Nephropathy. PAFMJ [Internet]. 2023 Feb 28 [cited 2023 Oct 31];73(1):199-203. Available from: https://www.pafmj.org/PAFMJ/article/view/3916

19. Khan A, Rauf A, Khan S, Sarfraz MH, Tarrar MS, Nisar M. Coagulation Profile in Diabetes and Its Association with Diabetic Microvascular Complications. PAFMJ [Internet]. 2023 Feb 24 [cited 2023 Oct 31];73(1):135-38. Available from: https://www.pafmj.org/PAFMJ/article/view/8260

20. Agarwal C, Bansal K, Pujani M, Singh K, Chauhan V, Rana D, et al. Association of Coagulation Profile with Microvascular Complications and Glycemic Control in Type 2 Diabetes Mellitus - A Study at a Tertiary Care Center in Delhi. Hematol Transfus Cell Ther. 2019 Apr 15;41:31-6.

21. Ali A, Abbasi AS, Nisar A. Progression of Albuminuria and Retinopathy with Duration of Diabetes Mellitus: Albuminuria and Retinopathy. PAFMJ [Internet]. 2018 Aug 31 [cited 2023 Oct 31];68(4):767-72. Available from: https://www.pafmj.org/PAFMJ/article/view/72