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ORIGINAL ARTICLE

Prevalence of microalbuminuria and associated factors in patients with type 2 diabetes mellitus.

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ABSTRACT… Objective: To determine the prevalence of microalbuminuria and identify associated demographic and clinical factors in type 2 diabetic patients. **Study Design:** Cross-sectional Analytical study. **Setting:** Department of Medicine, Combined Military Hospital Multan. **Period:** Nov-2024 to Apr-2025. **Methods:** A total of 126 patients diagnosed with type 2 diabetes mellitus for ≥2 years were enrolled in this study. Baseline demographics, clinical history, and results of laboratory parameters were recorded. Patients were defined as having microalbuminuria when urinary albumin-to-creatinine ratio was 30-300 mg/g. Demographic and clinical risk factors were compared between patients diagnosed with microalbuminuria and those without it to determine the factors associated with the development of microalbuminuria by applying chi-square tests and independent t-tests keeping $p<0.05$ as statistically significant. **Results:** The mean age was 51.34±7.53 years with nearly equal gender distribution. The prevalence of microalbuminuria was found to be 21.4%. Patients diagnosed with microalbuminuria had significantly higher age (54.67±7.22 vs 50.47±7.42 years, p=0.01), male predominance (70.37% vs 45.45%, p=0.02), longer diabetes duration (12.7±4.14 vs 9.41±4.61 years, p<0.01), uncontrolled diabetes (81.48% vs 60.61%, p=0.04), uncontrolled hypertension (51.85% vs 18.18%, p<0.01). These patients also had higher prevalence of hypertension (p=0.02) and obesity (p=0.04), higher BMI (p=0.04) and smoking rates (p=0.01). **Conclusion:** A notable proportion of type 2 diabetic patients also develop microalbuminuria. Older age, male gender, longer duration of diabetes, poor glycemic control, hypertension, obesity, and smoking are significantly associated factors in the development of microalbuminuria in these patients.

Key words: Diabetic Nephropathy, Microalbuminuria, Risk Factors, Type 2 Diabetes Mellitus.

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INTRODUCTION

Diabetes mellitus (DM), is a chronic metabolic disorder marked by persistent hyperglycemia which results from defects in insulin secretion, insulin action, or both. The disease has become a global health crisis during past few decades and is the 9th leading cause of mortality, claiming nearly one million lives annually.[1] It is a matter of concern that prevalence of DM particularly Type-II diabetes mellitus (T2DM) is rising rapidly in developing nations, particularly in South Asia, with Pakistan reporting an alarming figure of 11.7% and experiencing escalating diabetes-related morbidity and mortality.[2] Comprehensive public health strategies and enhanced clinical care are urgently needed to combat this growing epidemic and preventing the debilitating complications.[3]

Diabetic nephropathy (DN) is a severe microvascular complication of T2DM. This complication often progresses to chronic kidney disease (CKD) and leads to end-stage renal disease (ESRD), which requires lifelong dialysis. In Pakistan, DN has reported to affect 31% of T2DM patients creating significant healthcare and economic burden, underscoring the need for implementation of screening and intervention strategies to mitigate its devastating consequences.[4]

The progression of DN to CKD thereby marks a significant stage, severely affecting patients' quality of life and survival. Microalbuminuria (MA), defined as urinary albumin-to-creatinine ratio (UACR) of 30-300 mg/g creatinine, is the early and the most sensitive marker of DN. MA in fact serves as a key diagnostic marker for identifying diabetic patients at risk of progressive damage to the kidneys. After the onset of T2DM, UACR testing is recommended by

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current guidelines after every 5 years using spot or random urine samples.[5,6]

Detection of MA occurs before the onset of overt proteinuria and marked as signs of renal dysfunction, offering a crucial window for timely therapeutic intervention. Early identification of renal dysfunction allows timely initiation of interventions to slow the disease progression. These interventions include improved glycemic and blood pressure (BP) control and the use of renin–angiotensin–aldosterone system (RAAS) inhibitors that helps to slow down the progression of DN.[7]

Risk factors of MA include hyperglycemia, hypertension, prolonged diabetes duration, obesity, dyslipidemia and smoking. These modifiable and non-modifiable factors interact in complex ways and accelerate kidney damage in diabetic patients.[8] Early detection enables timely intervention with intensive risk factor modification like strict glycemic control and blood pressure management. This also allows early initiation of renoprotective therapies like RAAS inhibitors (ACEIs/ARBs), which can slow the progression towards CKD.[9]

Understanding the prevalence and associations of these risk factors in specific populations is therefore, crucial for developing targeted prevention and management strategies. Numerous international studies have examined the prevalence of MA and the associated factors in T2DM, providing a good insight for planning the tailored interventions.[10] However, evidence from our national and regional population remains scarce. Understanding these patterns within the Pakistani context will help in developing targeted screening and intervention strategies. In particular, data from regions such as Multan that reflects our population's specific risk profile are notably limited.

This study, therefore, aimed to determine the prevalence of MA in patients with T2DM and to identify the associated demographic and clinical risk factors among those presenting to our tertiary care hospital. The findings of this study will reinforce the suggestions of routine MA screening in T2DM patients, enabling early intervention, better follow-up, and prevention of advanced nephropathy, ultimately improving the overall patient outcomes.

METHODS

This cross-sectional analytical study was conducted at the Department of Medicine, Combined Military Hospital Multan, from Nov-2024 to Apr-2025 over a period of six months following the approval from ethical committee of the hospital (ERC no. 111/2024. Dated 13 July 2024).

Sample size was calculated using OpenEpi calculator with a reported prevalence of MA in T2DM of 20% from previous literature.[11] With a confidence level of 95% and a margin of error of 7%, the calculated sample size (n) was 126 patients.

A total of 126 patients aged 30-65 years diagnosed with T2DM for ≥ 2-years (HbA1c >6.5%) reporting at the medical outpatient the department were enrolled in this study through consecutive sampling.[12] Written informed consent was obtained from each patient prior to their inclusion.

The exclusion criteria were set as patients currently receiving angiotensin converting enzyme inhibitors (ACE I) or Angiotensin Receptor Blocker (ARB) treatment. Patients who had used systemic corticosteroids (CS) within the last four weeks, and women with pregnancy were also excluded.

All the baseline demographic (age, gender, BMI, obesity status) and clinical history (duration of T2DM, current anti-diabetes treatment, presence of hypertension (HTN), and smoking history) were collected on a structured proforma. All the patients underwent an early morning complete urine examination. Urine samples were collected in sterile containers and then processed within two hours of collection for albumin and creatinine levels.

The UACR was calculated and patients were diagnosed with MA (and labeled as yes/no for MA) when UACR ranged between 30-300 mg/g creatinine in their early morning or spot urine samples.[13] Similarly, patients were defined as known hypertensive patients when they were receiving anti-hypertensive therapy for ≥1 year, documented in medical records. They were also classified as either controlled (BP <140/90 mmHg) or uncontrolled

hypertensive (BP ≥140/90 mmHg) patients.[14] Obesity was declared at Body Mass Index (BMI) ≥30 kg/m² while patients were recorded as smoker when they were currently smoking of ≥10 cigarettes per day for a minimum of 2 years.[15,16] A diabetic patient was declared "uncontrolled" when HbA1c is ≥8.0%, with >9.0% representing very poor/severely uncontrolled diabetes.[17]

Data was analyzed using SPSS version 25. The Shapiro-Wilk test was used to assess the normality of numerical variables (age, duration of T2DM, and BMI), which were then presented as mean ± standard deviation (SD) or median (range). Categorical variables (gender, and the status of hypertension, smoking and obesity, and presence of MA) were expressed as frequencies and percentages. Chi-square test was used for finding associations between MA and categorical variables, while independent t-tests/Mann–Whitney U tests were applied for continuous variables, keeping a p-value <0.05 as statistically significant.

RESULTS

The mean age in this study was 51.34±7.53 years (Ranged 39-65 years). There was high prevalence of co-morbidities like HTN and obesity. The details of demographics and baseline clinical history of study participants are shared in Table-I.

TABLE-I

Demographics and baseline clinical characteristics n = 126

Demographics		
Age (Mean± SD) years		51.34±7.53
Gender	Male n (%)	64 (50.8)
	Female n (%)	62 (49.2)
Baseline clinical characteristics		
BMI (Mean± SD) Kg/m²		28.62±4.18
Obesity	Yes n (%)	58 (46)
	No n (%)	68 (54)
Duration of diabetes (Mean± SD) years		10.14±4.72
HbA1C levels (Mean± SD) %		8.43±0.91
Uncontrolled diabetes n (%)		82 (65.08)
Hypertension n (%)		83 (65.9%)
Uncontrolled blood pressure n (%)		32 (25.4)
Smokers n (%)		30 (23.81)

The results of laboratory findings based on UACR showed that MA was present in 21.4% of diabetic patients, as shown in Table-II.

TABLE-II

Prevalence of MA n= 126

Prevalence of MA as per laboratory findings	
UACR* in overall study patients (Mean± SD) mg/g	36.01±38.22
Presence of MA** n (%)	27 (21.4)
UACR* in patients diagnosed with MA (Mean± SD) mg/g	104.74±25.06

Urine albumin/creatinine ratio*, Microalbuminuria**

The demographics and clinical characteristics of patients with MA showed significantly older age, male gender, duration of T2DM, uncontrolled diabetes, presence of HTN, uncontrolled HTN, higher BMI and higher prevalence of obesity compared to those without MA (all p<0.05), revealing significant association of these factors with the development of MA in T2DM, as shown in Table-III.

TABLE-III

Comparison of characteristics among patients with and without MA n = 126

Demographic and Clinical Characteristics	Patients with MA (N=27)	Patients Without MA (N=99)	P-Value
Age (Mean± SD) years	54.67±7.22	50.47±7.42	0.01
Male gender n (%)	19 (70.37)	45 (45.45)	0.02
Duration of diabetes (Mean± SD) years	12.7±4.14	9.41±4.61	<0.01
Uncontrolled diabetes n (%)	22 (81.48)	60 (60.61)	0.04
BMI (Mean± SD) Kg/m²	30.04±3.88	28.23±4.19	0.04
Presence of obesity n (%)	17 (62.96)	41 (41.44)	0.04
Presence of HTN n (%)	23 (85.19)	60 (60.6)	0.02
Uncontrolled HTN n (%)	14 (51.85)	18 (18.18)	<0.01
Smokers n (%)	12 (44.44)	18 (18.18)	0.01

DISCUSSION

The prevalence of MA was found to be 21.4%. Patients diagnosed with MA had significantly higher age (54.67±7.22 vs 50.47±7.42 years, p=0.01), male predominance (70.37% vs 45.45%, p=0.02),

longer diabetes duration (12.7±4.14 vs 9.41±4.61 years, p<0.01), uncontrolled diabetes (81.48% vs 60.61%, p=0.04), uncontrolled hypertension (51.85% vs 18.18%, p<0.01). These patients also had higher prevalence of hypertension (p=0.02) and obesity (p=0.04) and had higher BMI (p=0.04) and smoking rates (p=0.01). These findings of our study are consistent with the global trend of the prevalence of MA in type 2 diabetic patients, especially the regional data of South Asia and neighboring countries.

Bae ES et al. worked on a data collected in Korean population reported with T2DM and found that 17.63% had MA, while 78.66% had normoalbuminuria, with highest incidence in ≥70 years and low-income groups. Logistic regression identified systolic BP, low HDL, high fasting glucose, and anemia as significant risk factors.[18] A study conducted in Iran found a prevalence of MA 17.2**%** and macroalbuminuria 17.6**%**. MA was linked to longer diabetes duration, higher fasting glucose, and elevated diastolic BP. The investigator thereby recommended a strict glycemic and BP control to improve the outcomes in T2DM.[19]

Mohan MM investigated the prevalence of MA in 246 Indian T2DM patients. The prevalence was 24.8% which was more common in males and in patients with mean diabetes onset in their early 40s. Patients with MA also had longer duration of diabetes (an average of 9 years), higher systolic BP (135 mmHg), fasting glucose (172 mg/dl), cholesterol (181 mg/dl), and HbA1c (8.7%).[20] A similar proportion (20.3%) of prevalence of MA in diabetic patients was reported in a study in Nepal. Significant associations were found in patients with higher BMI (p=0.029), longer duration of diabetes (p<0.001), presence of hypertension (p<0.001), smoking (p<0.001), and sedentary lifestyle (p<0.001). Emphasis was made on early identification and modification of these identified factors to prevent the progression of the disease.[11] Similar genetic and lifestyle factors make these findings from the Indian subcontinent particularly relevant to our Pakistani population.

Sana MA et al. worked on a study in Lahore, Pakistan to assess the prevalence of MA in T2DM patients. Among 133 participants (mean age 54.5 years; 60.9% males), MA was reported in 25.6% of the patients (an additional 4.5% had macroalbuminuria). The incidence was correlated with longer diabetes duration (p=0.034) and uncontrolled glycemia (p=0.001).[21] This local data from Pakistan provides valuable insights into the burden of MA in our healthcare institutes. In a recently published study in Pakistan including 250 participants (200 T2DM, 50 controls), MA prevalence was significantly higher in diabetic patients (32%) than the controls (4%). The uncontrolled glycemic levels (assessed by elevated HbA1c) were correlated with albumin-to-creatinine ratio (r=0.42), serum urea (r=0.35), creatinine (r=0.38), fasting blood glucose and random blood glucose levels. Poor glycemic control emerged as the key risk factor in the development and progression of nephropathy.[22]

These data sharing high prevalence of MA and the consistent identification that poor glycemic control, hypertension, longer diabetes duration, and lifestyle factors as key risk factors reinforces the importance of comprehensive diabetes management and early screening for MA to prevent progression to overt DN.

Limitations of this study include the cross-sectional design which limited the chances of causal inferences. Moreover, this was a single-center study which may affect the generalizability of these results to the broader Pakistani diabetic population.

CONCLUSION

A notable prevalence of MA is recorded among T2DM patients in our population. Older age, male gender, prolonged diabetes duration, poor glycemic control, hypertension, uncontrolled hypertension, obesity, and smoking emerged as significant risk factors for the development of MA. These findings emphasize the importance of routine MA screening, particularly in those diabetic patients with multiple risk factors. This early detection through regular UACR monitoring, combined with aggressive management of the modifiable risk factors, can prevent the development and progression towards overt DN, improving long-term patient outcomes.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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2	**Javed Ahmad Khan:** Critical review.
3	**Faisal Naveed Akhtar:** Acquisition analysis.
4	**Farrukh Sher:** Design.
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6	**Hamna Wajid:** Interpretation of data.