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ORIGINAL ARTICLE

# Prevalence of Nephropathy in Type 2 Diabetes Mellitus

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## ABSTRACT

***Background & objective:*** Diabetic Nephropathy (DN) is a leading cause of end-stage renal disease (ESRD) worldwide, contributing significantly to morbidity and mortality in Type 2 Diabetes Mellitus (T2DM) patients. In Bangladesh, while the burden of diabetes is rising, there is limited data regarding the prevalence and clinical profile of DN in the Rajshahi region. This study aimed to determine the prevalence of nephropathy among T2DM patients and to evaluate the demographic, behavioral, and clinical characteristics associated with the condition.

***Methods:*** This descriptive cross-sectional study was conducted at the Rajshahi Diabetic Association General Hospital between June 2012 and May 2015. Out of 21,000 T2DM patients (attended during the study period) initially screened, 5,424 were identified with clinical suspicion of DN. Diagnosis was confirmed through microalbuminuria screening (NycoCard Reader II) and macroalbuminuria assessment [Albustix and Protein-Creatinine Ratio (PCR)] and prevalence of DN was calculated among patients who underwent confirmatory tests for nephropathy. Finally, demographic and clinical characteristics of this cohort was studied using descriptive statistics.

***Results:*** A total of 211 patients were confirmed to have nephropathy, representing a prevalence rate of 3.9% among the screened population. The mean age of affected patients was 65.7 ± 6.8 years, with an average diabetes duration of 21.5 ± 3.5 years. Suboptimal glycemic control was evident with a mean HbA1c of 7.1 ± 0.6%. Significant comorbidities were observed, including anemia (51.7%) and hypertension (24.6%). Despite high reported rates of diet control (90.1%) and a mean BMI of 23.2 ± 2.8 kg/m², a notable proportion of patients progressed to advanced albuminuria.

***Conclusion:*** The prevalence of nephropathy in this cohort underscores the critical need for early screening and aggressive management of glycemic levels and blood pressure. The high incidence of anemia suggests that renal impairment is often advanced by the time of clinical detection. Early intervention with reno-protective agents such as ACE inhibitors and ARBs is recommended to delay progression to ESRD.


***Keywords:*** Type 2 Diabetes Mellitus, Diabetic Nephropathy, Prevalence, Microalbuminuria.

## INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both.[1] It constitutes a major global public health challenge with its impact most severely felt among working-age adults in developing countries. According to the International Diabetes Federation (IDF), the global prevalence of diabetes in 2013 was 8.3% among adults aged 20–79, affecting approximately 382 million people. This figure is projected to rise to 592 million by 2035.[2]

Type 2 diabetes (T2DM) is the most prevalent form of diabetes, accounting for approximately 90% of all

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cases.[2] The surge in T2DM prevalence, particularly in low and middle income counties (LMICs), is driven by rapid urbanization, nutrition transition, and increasingly sedentary lifestyles.[3] While some risk factors such as age, family history, and race (specifically African-American, Latino, and Asian-American populations) are non-modifiable, others such as obesity, physical inactivity, and smoking are modifiable.[4]

Chronic hyperglycemia leads to significant long-term tissue damage, manifesting as microvascular complications like retinopathy, neuropathy, & nephropathy.[5] Diabetic nephropathy (DN), also known as Kimmelstiel-Wilson syndrome, is a progressive kidney disease caused by angiopathy of the renal glomerular capillaries.[6] It is characterized by persistent albuminuria and diffuse glomerulosclerosis, serving as the leading cause of end-stage renal disease (ESRD) globally. Approximately one-third of individuals with diabetes develops nephropathy.[7] The natural history of DN typically begins with incipient nephropathy (microalbuminuria), appearing 10 to 15 years after the onset of DM, and can progress to overt nephropathy (macroalbuminuria) and eventually ESRD, where survival rates are notably low.[8] In T2DM, microalbuminuria is often a sign of broader endothelial dysfunction, with 40 to 50% of these patients dying from cardiovascular disease before reaching ESRD.[9]

In Bangladesh, DM is a significant cause of morbidity and mortality, placing a heavy burden on healthcare resources. Despite the rising number of cases, the prevalence and specific characteristics of diabetic nephropathy patients have not been extensively studied within the local context, particularly in the Rajshahi division. This study aims to fill this gap by determining the prevalence of nephropathy among T2DM patients attending the Rajshahi Diabetic Association General Hospital and demographic and clinical characteristics of the population affected with the condition.

## METHODS:

This descriptive cross-sectional study was conducted as part of a doctoral research project at the Institute of Biological Sciences, University of Rajshahi, in collaboration with the Rajshahi Diabetic Association General Hospital, Rajshahi, Bangladesh. The study period spanned from June 2012 to May 2015. Ethical clearance was obtained from the Ethical Review Committee (ERC) of Rajshahi Medical College prior to the commencement of the study.

A total of 21,000 Type 2 diabetic patients aged 30–80 years attending the Rajshahi Diabetic Association General Hospital were initially screened for clinical suspicion of diabetic nephropathy. Type 2 Diabetes Mellitus (T2DM) patients of either sex, aged 30–80 years, who provided informed consent were included in the study. Patients with pre-existing renal calculi, prostatic hypertrophy, established cardiovascular disease, multisystemic diseases (e.g., Systemic Lupus Erythematosus), hereditary kidney diseases, or significant sensory impairments (hearing or visual) were excluded.

From the initial pool, a focused screening of 5,424 patients was conducted to identify albuminuria. The diagnostic pathway was divided into two primary arms:

1. Microalbuminuria Screening (n = 429): Evaluated using the NycoCard Reader II.
2. Macroalbuminuria Screening (n = 4,995): Evaluated using Albustix (dipstick).

Screening was conducted to diagnose microalbuminuria (presence of albumin 20-200µg/ml in urine). Patients with levels > 200 µg/ml or positive dipstick results for macroalbuminuria were further subjected to a Protein-Creatinine Ratio (PCR) test for quantification and detection of nephropathy. Early morning mid-stream urine specimens (10–20 ml) were collected in labeled, sterile containers for detection of albuminuria.

Microalbuminuria was measured using the NycoCard® U-Albumin assay, a solid-phase immunometric sandwich format.

- **Principle:** Immobilized albumin-specific monoclonal antibodies capture albumin in the sample, which then binds to a gold-antibody conjugate to produce a purple color.

ORIGINAL ARTICLE

- **Procedure:** A 50 µL diluted urine sample was applied to the test device, followed by the gold conjugate and a washing solution. Quantitative measurements were recorded using the NycoCard® READER II densitometer.[10]
- **Reference Range:** Defined as a urine albumin concentration of 20–200 mg/L.[11]

**Macroalbuminuria was assessed through two methods:**

1. **Albustix (Dipstick):** This test is based on the "protein-error-of-indicators" principle. The reagent area (tetrabromphenol blue) changes color from yellow to green-blue in the presence of protein at a constant pH.
2. **Protein-Creatinine Ratio (PCR):** While urinary protein was measured via the colorimetric Pyrogallol red method,[12] urinary creatinine was measured via the Jaffe-Kinetic method using an automated analyzer.[13]

- **Calculation:** PCR was calculated by dividing the urine protein by the urine creatinine and result was expressed in mg/g. PCR = Urine Protein (mg) / Urine Creatinine (g).
- **Clinical Grading:** Normal (< 133 mg/g), Trace proteinuria (133–256 mg/g), Proteinuria +/++ (256–3094 mg/g), and Nephrotic range +++ (> 3094 mg/g).[14]

Data were analyzed using SPSS (Statistical Package for Social Sciences), version 25. Descriptive statistics were used to describe the population in terms of their demographic, behavioural and clinical characteristics. The test statistics used to analyze the data were frequency and corresponding percentages (for qualitative data), and mean, standard deviation (SD) and range for quantitative data.

## RESULTS

The screening and diagnostic phase of the study revealed that out of 21,000 Type 2 diabetes patients attending the Rajshahi Diabetic Association General Hospital, 5,424 (25.8%) were initially identified with a clinical suspicion of diabetic nephropathy. All of them were subjected to confirmatory biochemical tests for nephropathy.

### Prevalence and Diagnostic Outcomes

The diagnostic classification was based on the severity of albuminuria. Among those screened (n= 5424), 158(2.9%) patients were diagnosed with microalbuminuria (20–200 µg/ml). Macroalbuminuria was initially detected in 45(0.8%) patients via dipstick. For precise quantification, 53 patients (the 45 dipstick-positive cases plus 8 patients from the microalbuminuria group with levels > 200 µg/ml) underwent Protein-Creatinine Ratio (PCR) testing; all of whom were confirmed as having nephropathy (advanced albuminuria). Detailed biochemical analysis confirmed nephropathy in 211 of them, yielding a prevalence rate of 3.9% among the screened population (Table I).

### Demographic and Behavioral Profile

The mean age of the nephropathy cohort was 65.7 ± 6.8 years, reflecting a predominance of older patient demographic. Gender distribution was relatively identical, though females (51.7%) slightly outnumbered males (48.3%) (Table II). Regarding behavioral characteristics, more than half (53.6%) of the participants maintained an active lifestyle. Dietary control was notably high, with > 90% of patients reporting well-controlled dietary habits. The mean Body Mass Index (BMI) was 23.2 ± 2.8 kg/m$^2$, suggesting that the majority of the patients were within the normal weight range. A sizable portion (19.4%) of the DN patients reported a history of smoking (Table III).

### Comorbidities and Clinical Findings

Clinical assessment revealed significant comorbidities within the study group. More than half of the patients (51.7%) were found to be anaemic, while nearly one-quarter (24.6%) suffered from concurrent hypertension (Table IV).

The duration of diabetes was a prominent factor, with a mean of 21.5 ± 3.5 years since diagnosis. Additionally, 20.4% of patients reported a family history of the disease. Glycemic control appeared suboptimal for many, as evidenced by a mean

HbA1c of 7.1 ± 0.6%, indicating a notable proportion of patients with poorly controlled blood sugar levels (Table V).

**Table I: Summary of Screening and Diagnostic Tests for diabetic nephropathy**

| Test Parameter | Methods / Material | Total Screened | Positive Cases |
|---|---|---|---|
| Microalbuminuria | NycoCard Reader II | 429 | 158 |
| Macroalbuminuria | Albustix (Dipstick) | 4995 | 45 |
| Advanced Albuminuria | PCR (Automated) | 53* | 53 |
| **Total Nephropathy** | | **211** | |

*Includes 8 patients from the microalbuminuria group with levels >200 µg/ml and 45 from the dipstick group.

**Table II: Demographic characteristics of the patients (n = 211)**

| Demographic characteristics | Frequency | Percentage | Mean ± SD |
|---|---|---|---|
| **Age# (years)** | -- | -- | 65.7 ± 6.8 |
| **Sex*** | | | |
| Male | 102 | 48.3 | -- |
| Female | 109 | 51.7 | -- |

**Table III: Distribution of patients by their behavioral characteristics (n = 211)**

| Behavioral characteristics | Frequency | Percentage | Mean ± SD |
|---|---|---|---|
| **Life style** | | | |
| Active | 113 | 53.6 | -- |
| Sedentary | 98 | 46.4 | -- |
| **Diet control** | | | |
| Well-controlled | 190 | 90.1 | -- |
| Moderately controlled | 16 | 7.5 | -- |
| Uncontrolled | 5 | 2.4 | -- |
| **Smoking habit** | 41 | 19.4 | -- |
| **BMI (kg/m$^2$)** | -- | -- | 23.2 ± 2.8 |

**Table IV: Distribution of patients by presence of comorbidities (n = 211)**

| Comorbidities | Frequency | Percentage |
|---|---|---|
| Anemia | 109 | 51.7 |
| Hypertension | 52 | 24.6 |

**Table V: Distribution of patients by diabetes-related findings (n = 211)**

| Diabetes related variables | Frequency | Percentage | Mean ± SD |
|---|---|---|---|
| Duration of DM# (yrs.) | -- | -- | 21.5 ± 3.5 |
| Family H/O DM | 43 | 20.4 | -- |
| HbA1c# (%) | -- | -- | 7.1 ± 0.6 |

## DISCUSSION

The findings of this study provide a critical insight into the burden of diabetic nephropathy (DN) within the Rajshahi division of Bangladesh. While the confirmed prevalence of 3.9% among the screened population appears lower than some global estimates, it represents a significant clinical cohort given the high volume of diabetic patients in the region.

### Prevalence and Diagnostic Context

The observed prevalence of 3.9% (211 out of 5,424 screened) specifically highlights those with confirmed albuminuria. This figure must be viewed in the context of our screening methodology, where 25.8% of the initial 21,000 patients were suspected of having renal involvement based on clinical presentation. The identification of 158 cases of microalbuminuria and 53 cases of advanced albuminuria (macroalbuminuria) underscores the progressive nature of the disease described by Parving et al[8]. The fact that 53 patients required PCR quantification (PCR < 133 mg/g) indicates that a substantial portion of patients are already in the "overt nephropathy" stage at the time of clinical evaluation.

### Association with Clinical and Demographic Factors

The mean age of 65.7 years and the long mean duration of diabetes (21.5 ± 3.5 years) align with the established natural history of DN, which typically manifests after decades of metabolic stress on the renal vasculature.[6] Suboptimal glycemic control, evidenced by a mean HbA1c of 7.1 ± 0.6%, remains a primary driver for renal complications. This is consistent with the findings from the UKPDS[15] and DCCT[16] trials, which established that chronic hyperglycemia triggers the production of advanced glycation end products (AGEs) and oxidative stress, leading to glomerular basement membrane thickening.

### The Role of Comorbidities

The high prevalence of anemia (51.7%) in the study group is particularly noteworthy. Anemia is

ORIGINAL ARTICLE

both a complication of and a contributor to the progression of chronic kidney disease (CKD), often resulting from reduced erythropoietin production as renal function declines. Furthermore, the presence of hypertension in 24.6% of patients reinforces the need for aggressive RAAS blockade using ACE inhibitors or ARBs, as hypertension acts as a potent accelerator of the transition from microalbuminuria to ESRD.[7]

### Implications for Local Healthcare

Despite a high rate of reported diet control (90.1%) and a majority maintaining a normal BMI (23.2 ± 2.8 kg/m²), the development of nephropathy in these patients suggests that metabolic duration and possible genetic predispositions suggested by the 20.4% family history rate may override behavioral modifications in the long term. This highlights a gap in early screening in the Rajshahi region, as many patients may remain undiagnosed until microvascular damage is well-advanced.

## CONCLUSION

This study establishes a significant prevalence of diabetic nephropathy (3.9%) among Type 2 diabetes patients in the Rajshahi division of Bangladesh. The clinical profile of these patients characterized by an average age of 65 years, a long duration of diabetes (over 21 years), and suboptimal glycemic control (mean HbA1c of 7.1%) confirms that renal complications are a major long-term consequence of T2DM in this region. Notably, more than half of the patients with nephropathy also suffered from anemia, indicating that renal involvement is already impacting systemic health and erythropoietin production.

While many patients reported adherence to diet and active lifestyles, the high rate of advanced albuminuria suggests that current management strategies may be insufficient to halt microvascular damage. The results underscore that in a clinical setting like Bangladesh, diabetic nephropathy remains a silent but progressive threat that consumes significant healthcare resources. The following recommendations are put forward to control and delay the progression of diabetic nephropathy in Type 2 diabetic patients.

### Recommendations

- **Early & Routine Screening:** Implementation of mandatory annual microalbuminuria screening for all T2DM patients immediately upon diagnosis, rather than waiting for clinical symptoms or long disease duration.
- **Aggressive Management of Comorbidities:** Enhanced focus on controlling hypertension and treating anemia in diabetic patients, as these factors significantly accelerate the progression to end-stage renal disease (ESRD).
- **Optimization of Pharmacotherapy:** Widespread use of ACE inhibitors and ARBs should be prioritized in patients showing early signs of albuminuria to take advantage of their reno-protective properties.
- **Patient Education:** While diet control was reported as high, the suboptimal HbA1c levels suggest a need for better education on the difference between "dietary restriction" and "glycemic targets."
- **Further Longitudinal Research:** Larger, multi-center longitudinal studies are needed in Bangladesh to compare the long-term efficacy of ACE inhibitors versus ARBs in the local population to refine treatment protocols.

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