

Relationship of Microalbuminuria with Renal Function Markers in Postmenopausal Women with Type 2 Diabetes Mellitus

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Abstract

Background: Diabetes mellitus (DM) is a major global health concern causing multi-organ complications, with postmenopausal women being particularly vulnerable due to hormonal and metabolic changes. This study aimed to evaluate the association between microalbuminuria and renal function markers in postmenopausal women with type 2 diabetes mellitus. **Aim of the study:** The aim of the study was to evaluate the association between microalbuminuria and renal function markers in postmenopausal women with type 2 diabetes mellitus. **Methods:** This cross-sectional study at the Department of Biochemistry, Dhaka Medical College, Dhaka, Bangladesh (July 2014–June 2015) included 100 postmenopausal women with type 2 diabetes to assess the association of microalbuminuria with renal function markers. After ethical approval and consent, fasting blood and morning urine samples were collected to measure glucose, HbA1c, serum albumin, serum creatinine, urinary creatinine, microalbuminuria, and ACR. Data were analyzed using SPSS 21 with t-tests and Pearson's correlation; $p < 0.05$ was significant. **Results:** In 100 postmenopausal women with type 2 diabetes, 78% were microalbuminuria positive. Prevalence was 94.4% with abnormal serum albumin, 100% with raised ACR, and 91.7% with raised serum creatinine. Microalbuminuria correlated strongly with serum albumin ($r = -0.750$), urinary creatinine ($r = -0.762$), ACR ($r = +0.997$), and serum creatinine ($r = +0.694$), all $p = 0.001$. **Conclusion:** Microalbuminuria is strongly associated with renal function markers, highlighting the need for early detection of kidney dysfunction in postmenopausal women with type 2 diabetes in Bangladesh.

Key words: Microalbuminuria, Renal Function, Postmenopausal Women.

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INTRODUCTION

Diabetes mellitus (DM) represents a major global health challenge and is one of the four priority chronic non-communicable metabolic disorders that significantly alter the body's anatomical and physiological functions, leading to a wide array of complications [1]. Globally, the prevalence of diabetes in 2019 was estimated at 463 million, with projections suggesting an increase to 578 million by 2030 and potentially reaching 700 million by 2045 if secondary complications are not adequately addressed [2]. Type 2 diabetes constitutes over 85% of all cases and is linked with both microvascular and macrovascular complications [3]. These complications affect critical organs such as the kidneys, heart, eyes, and peripheral

nerves, resulting in heightened morbidity and mortality [4]. Postmenopausal women with type 2 diabetes are particularly susceptible, as hormonal changes during menopause exacerbate metabolic disturbances and vascular risks.

Diabetic nephropathy (DN) is an increasingly significant health issue, representing a major risk factor for the development of chronic kidney disease (CKD) and eventual progression to end-stage renal failure. Diabetic nephropathy is a major contributor to illness and death in individuals with type 2 diabetes [5,6]. It often begins with microalbuminuria and may advance to macroalbuminuria, accompanied by a gradual reduction in glomerular filtration rate (GFR), ultimately

progressing to end-stage renal disease (ESRD). Early recognition and intervention are therefore critical to preventing further renal deterioration and improving clinical outcomes, particularly in high-risk groups such as postmenopausal women with type 2 diabetes [7].

Microalbuminuria (MAU) serves as a crucial predictor for the development of both renal and cardiovascular complications in individuals with diabetes. Recognized as an early marker of diabetic nephropathy [8], it is defined by urinary albumin excretion ranging from 30 to 300 mg over 24 hours [9]. Stage 1 diabetic nephropathy is typically identified by the presence of microalbuminuria, which facilitates timely implementation of preventive and therapeutic strategies aimed at slowing the progression toward overt nephropathy. In addition to signaling renal risk, microalbuminuria has prognostic value for cardiovascular outcomes and is recommended for annual screening in all diabetic patients to ensure early detection of renal involvement [10].

Monitoring diabetic nephropathy involves assessment of proteinuria and serum creatinine, which reflect glomerular damage and permit calculation of the estimated glomerular filtration rate (eGFR) [10]. Although 24-hour urine collection has traditionally been used, it is cumbersome and inconvenient. The albumin-creatinine ratio (ACR) from an early morning spot urine sample is now considered a practical, cost-effective, and reliable alternative that closely correlates with 24-hour albumin excretion [10]. Combined with measurements of serum creatinine, serum albumin, and urinary creatinine, these renal function markers provide a comprehensive evaluation of kidney health and play a key role in the early identification of diabetic renal complications.

Despite the well-established link between diabetes and renal complications, limited research has explored how microalbuminuria relates specifically to renal function markers among postmenopausal women with type 2 diabetes—a group at heightened risk due to hormonal and metabolic changes. Most existing studies have focused on the general diabetic population, leaving a gap in understanding the renal alterations unique to this subgroup. Addressing this gap is essential for early detection and management of renal dysfunction in postmenopausal diabetic women. The purpose of the study is to evaluate the association between microalbuminuria and renal function markers in postmenopausal women with type 2 diabetes mellitus.

OBJECTIVE

- To evaluate the association between microalbuminuria and renal function markers in

postmenopausal women with type 2 diabetes mellitus.

METHODOLOGY & MATERIALS

This cross-sectional study was conducted at the Department of Biochemistry, Dhaka Medical College, Dhaka, Bangladesh, from July 2014 to June 2015. A total of 100 postmenopausal women with type 2 diabetes mellitus were enrolled using purposive sampling to evaluate the association of microalbuminuria with renal function markers.

Inclusion Criteria:

- Postmenopausal women diagnosed with type 2 diabetes mellitus
- Age between 45 and 65 years

Exclusion Criteria:

- Pregnancy or lactation
- Hypertension
- History of total hysterectomy or unilateral/bilateral oophorectomy
- Acute or chronic debilitating diseases such as COPD, renal failure, or malignancy

Ethical clearance was obtained from the Ethical Review Committee of Dhaka Medical College, and written informed consent was obtained from all participants.

Data and Sample Collection:

Postmenopause was defined as the permanent cessation of menstruation for at least 12 months due to loss of ovarian follicular function. After overnight fasting, 10 mL of venous blood and 5 mL of morning urine were collected aseptically. Samples were either analyzed immediately or stored at -20°C until analysis. Biochemical parameters measured included fasting plasma glucose, HbA1c, serum albumin, serum creatinine, urinary creatinine, microalbuminuria, and albumin-creatinine ratio (ACR).

Data Collection and Analysis:

Demographic and medical data were obtained through clinical evaluation, history-taking, and review of diabetes records, and recorded in a pre-designed data sheet. Laboratory investigations were performed according to standard reference ranges. Statistical analysis was conducted using SPSS version 21. Continuous variables were expressed as mean \pm SD, differences between microalbuminuria-positive and -negative groups were compared using the unpaired t-test, and correlations between variables were assessed using Pearson's correlation. A p-value <0.05 was considered statistically significant.

RESULTS

Table 1: Distribution of Microalbuminuria According to Serum Albumin Levels in the Study Population (n = 100)

| Serum Albumin (g/dl) | n | Microalbuminuria Positive, n (%) | Microalbuminuria Negative, n (%) | p-value |
|----------------------|-----|----------------------------------|----------------------------------|---------|
| Normal (3.5–5.5) | 28 | 10 (35.7%) | 18 (64.3%) | |
| <3.5 or >5.5 | 72 | 68 (94.4%) | 4 (5.6%) | |
| Total | 100 | 78 | 22 | |
| Mean ± SD | | 2.69 ± 0.71 | 3.90 ± 0.52 | 0.001 |

Table 1 presents the distribution of microalbuminuria according to serum albumin levels in the study population (n = 100). Among participants, 72 had abnormal serum albumin (<3.5 or >5.5 g/dl), of whom 68 (94.4%) were microalbuminuria positive. In contrast, only 10 of 28 patients (35.7%) with normal

serum albumin had microalbuminuria. The mean serum albumin was significantly lower in microalbuminuria-positive participants (2.69 ± 0.71 g/dl) compared to microalbuminuria-negative participants (3.90 ± 0.52 g/dl), with a p-value of 0.001.

Table 2: Distribution of Microalbuminuria According to Albumin-Creatinine Ratio (ACR) in the Study Population (n = 100)

| ACR (mg/g) | n | Microalbuminuria Positive, n (%) | Microalbuminuria Negative, n (%) | p-value |
|------------------|-----|----------------------------------|----------------------------------|---------|
| Normal (<30) | 26 | 4 (15.4%) | 22 (84.6%) | |
| Raised (>30) | 74 | 74 (100.0%) | 0 (0.0%) | |
| Total | 100 | 78 | 22 | |
| Mean ± SD | | 69.89 ± 17.31 | 21.64 ± 1.99 | 0.001 |

Table 2 shows the relationship between ACR and microalbuminuria. Among participants, 74 had raised ACR (>30 mg/g), all of whom (100%) were microalbuminuria positive. In contrast, only 4 of 26 patients (15.4%) with normal ACR (<30 mg/g) were

microalbuminuria positive. The mean ACR was significantly higher in microalbuminuria-positive participants (69.89 ± 17.31 mg/g) compared to microalbuminuria-negative participants (21.64 ± 1.99 mg/g), with a p-value of 0.001.

Table 3: Distribution of Microalbuminuria According to Serum Creatinine Levels in the Study Population (n = 100)

| Serum Creatinine (mg/dl) | n | Microalbuminuria Positive, n (%) | Microalbuminuria Negative, n (%) | p-value |
|--------------------------|-----|----------------------------------|----------------------------------|---------|
| Normal (0.55–1.02) | 28 | 12 (42.9%) | 16 (57.1%) | |
| Raised (>1.02) | 72 | 66 (91.7%) | 6 (8.3%) | |
| Total | 100 | 78 | 22 | |
| Mean ± SD | | 2.30 ± 0.69 | 1.38 ± 0.25 | 0.001 |

Table 3 illustrates microalbuminuria distribution according to serum creatinine levels. Among participants, 72 had raised serum creatinine (>1.02 mg/dl), of whom 66 (91.7%) were microalbuminuria positive. In comparison, only 12 of 28 patients (42.9%)

with normal serum creatinine were microalbuminuria positive. The mean serum creatinine was significantly higher in microalbuminuria-positive participants (2.30 ± 0.69 mg/dl) compared to microalbuminuria-negative participants (1.38 ± 0.25 mg/dl), with a p-value of 0.001.

Table 4: Correlation of Microalbuminuria with Renal Function Parameters in the Study Population (n = 100)

| Parameter | Pearson Correlation (r) | p-value |
|--------------------------------|-------------------------|---------|
| Serum Albumin | -0.750** | 0.001 |
| Urinary Creatinine | -0.762** | 0.001 |
| Albumin-Creatinine Ratio (ACR) | +0.997** | 0.001 |
| Serum Creatinine | +0.694** | 0.001 |

Table 4 shows the correlations between microalbuminuria and renal function markers. Microalbuminuria demonstrated a strong negative correlation with serum albumin (r = -0.750) and urinary

creatinine (r = -0.762), and a strong positive correlation with ACR (r = +0.997) and serum creatinine (r = +0.694), all statistically significant (p = 0.001).

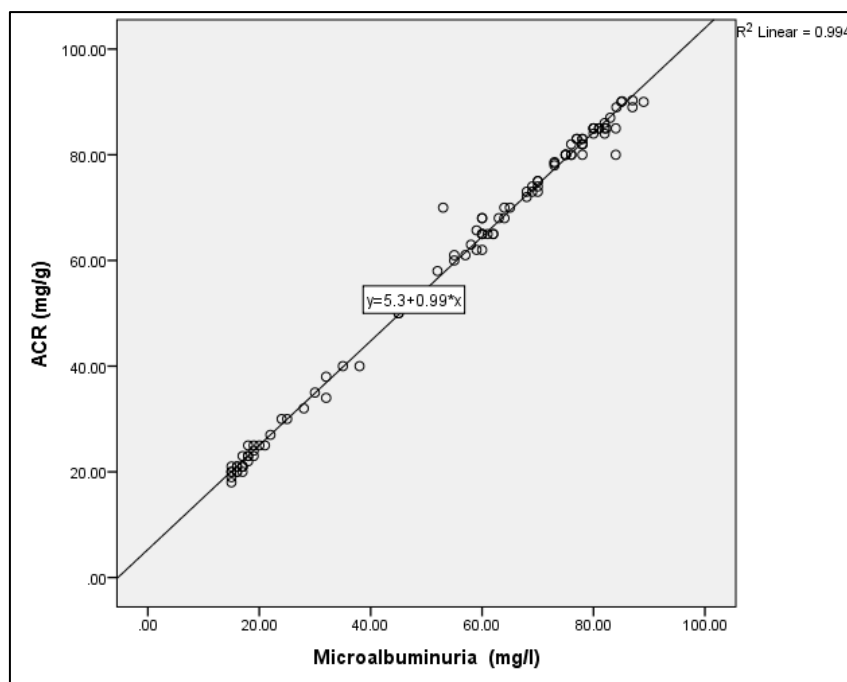


Figure 1: Scatter Diagram Showing the Correlation Between Microalbuminuria and Albumin-Creatinine Ratio (ACR) in the Study Population (n = 100)

DISCUSSION

Microalbuminuria, an early indicator of diabetic nephropathy, reflects subtle renal damage before overt clinical manifestations appear. The findings of this study highlight the close association between microalbuminuria and key renal function markers such as serum creatinine, serum albumin, urinary creatinine, and albumin-creatinine ratio (ACR). The strong correlations observed emphasize the importance of regular screening for microalbuminuria and related renal parameters in postmenopausal women with type 2 diabetes, as early identification and intervention may help prevent or delay the progression of diabetic kidney disease.

In this study, a significant relationship was observed between serum albumin levels and microalbuminuria among postmenopausal women with type 2 diabetes. Participants with abnormal serum albumin (<3.5 or >5.5 g/dL) showed a markedly higher prevalence of microalbuminuria (94.4%) compared to those with normal serum albumin (35.7%), with mean serum albumin significantly lower in microalbuminuria-positive patients (2.69 ± 0.71 g/dL) than in negative patients (3.90 ± 0.52 g/dL, $p = 0.001$). These findings align with Basi *et al.*, [11], who reported that hypoalbuminemia often reflects underlying diabetic nephropathy and systemic inflammation in postmenopausal diabetic women. Evidence from OHSU further supports that serum albumin <3.5 g/dL is associated with increased urinary albumin excretion and reduced eGFR [12], highlighting its value as an early renal marker. Monitoring serum albumin is therefore crucial, as patients with low albumin and

microalbuminuria may benefit from early interventions such as ACE inhibitors or ARBs to slow nephropathy progression.

A strong association was also observed between elevated albumin-creatinine ratio (ACR) and microalbuminuria. All 74 participants with raised ACR (>30 mg/g) were microalbuminuria positive, whereas only 4 of 26 participants with normal ACR (<30 mg/g) had microalbuminuria, with mean ACR significantly higher in microalbuminuria-positive patients (69.89 ± 17.31 mg/g vs. 21.64 ± 1.99 mg/g, $p = 0.001$). These results are consistent with Rasaratnam *et al.*, [13], who highlighted ACR as a robust diagnostic and prognostic marker for diabetic kidney disease, with levels above 30 mg/g associated with increased risk of microalbuminuria and progression to macroalbuminuria. This reinforces the utility of ACR threshold-based risk stratification for early renal impairment detection in postmenopausal women with T2DM.

Similarly, a significant association was observed between serum creatinine levels and microalbuminuria. Participants with raised serum creatinine (>1.02 mg/dL) had a markedly higher prevalence of microalbuminuria (91.7%) compared to those with normal creatinine (42.9%), with mean serum creatinine significantly higher in positive patients (2.30 ± 0.69 mg/dL vs. 1.38 ± 0.25 mg/dL, $p = 0.001$). These findings correspond with Chaamba *et al.*, [14], who reported higher serum creatinine in microalbuminuria-positive patients, and with Na *et al.*, [15], who demonstrated a strong correlation between elevated creatinine and microalbuminuria, particularly in insulin-resistant individuals. These results highlight serum

creatinine as a reliable renal marker for early detection of diabetic nephropathy.

Finally, microalbuminuria showed significant correlations with renal function markers: a strong negative correlation with serum albumin ($r = -0.750$, $p = 0.001$) and urinary creatinine ($r = -0.762$, $p = 0.001$), and a strong positive correlation with ACR ($r = +0.997$, $p = 0.001$) and serum creatinine ($r = +0.694$, $p = 0.001$). These correlations are consistent with Ren *et al.*, [16], who reported that elevated UACR was associated with increased urinary albumin excretion and metabolic disturbances, and Lee *et al.*, [17], who emphasized ACR as a biomarker for renal complications and systemic risks. Collectively, these results reinforce the utility of monitoring serum albumin, urinary creatinine, ACR, and serum creatinine as early indicators of nephropathy in postmenopausal women with T2DM.

Limitations of the study

Although optimal care was taken by the researcher at every step of the study, there were some limitations:

- Urinary albumin was measured only once, which may not reflect long-term variations.
- The study was conducted in a single hospital, so the findings may not be generalizable to the wider community.
- The sample size was relatively small due to time and cost constraints, which may limit the representativeness of the results; a larger sample could provide more robust findings.

CONCLUSION

In postmenopausal women with type 2 diabetes, microalbuminuria was closely associated with key renal function markers, including serum albumin, albumin-creatinine ratio, and serum creatinine. Patients with abnormal renal parameters had a higher prevalence of microalbuminuria, and correlation analysis confirmed strong associations between microalbuminuria and these markers. These findings emphasize the importance of routine monitoring of renal function for early detection and management of diabetic kidney disease in postmenopausal women with type 2 diabetes in Bangladesh.

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