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ORIGINAL ARTICLE

Relationship of Microalbuminuria with HbA1c and Other Renal Function Parameters in Type 2 Diabetic Post Menopausal Women

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ABSTRACT
Background: *Type 2 diabetes mellitus (T2DM) is a growing global health concern, with Bangladesh projected to rank 8th in adult diabetes prevalence by 2030 [1–4]. Microalbuminuria, an early marker of diabetic nephropathy linked to poor glycemic control, predicts renal and cardiovascular complications [5,6]. This study aims to assess the correlation between microalbuminuria, glycemic control, and renal function parameters in postmenopausal women with T2DM.* ***Aim of the study:*** *The aim of the study was to evaluate the association between microalbuminuria, HbA1c levels, and renal function parameters in postmenopausal women with type 2 diabetes at DMCH.* ***Methods & Materials:*** *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 from the endocrine outpatient department. Blood and urine samples were analyzed for glucose, HbA1c, albumin, creatinine, microalbuminuria, and ACR. Data were processed using SPSS v21; p<0.05 was considered significant.* ***Results:*** *Among 100 postmenopausal women with T2DM, 78% had microalbuminuria. All patients with diabetes >5 years and 94.4% with hypoalbuminemia were microalbuminuria positive. Significant correlations were found with ACR (r=0.997), HbA1c (r=0.75), FBS (r=0.717), S. creatinine (r=0.694), S. albumin (r=–0.750), and U. creatinine (r=–0.762) (p=0.001).* ***Conclusion:*** *Microalbuminuria is common in diabetic postmenopausal women in Bangladesh, and early screening can help prevent diabetic complications and chronic kidney disease.*

Keywords: *Microalbuminuria, HbA1c, Renal Function, Type 2 Diabetes Mellitus, Postmenopausal Women*

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INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a global health problem of enormous magnitude, affecting an estimated 5–7% of the world's population [1]. Its prevalence is projected to increase from 285 million in 2010 to 439 million by 2030. Currently, the prevalence of diabetes among people aged 20–79 years worldwide is 6.6%, with impaired glucose tolerance affecting approximately 7.9% of the population [2]. Bangladesh is expected to rank 8th in total cases of diabetes among adults aged 20–79 years by 2030 [3]. Therefore, prevention and control of diabetes should be a top public health priority, particularly in Asian populations [4].

Diabetes mellitus is a clinical syndrome characterized by hyperglycemia resulting from absolute or relative insulin deficiency. Hyperglycemia may arise from various causes but is most commonly due to type 1 or type 2 diabetes. T2DM has long been recognized as a major public health issue with significant consequences for individual health and economic burden on the healthcare system. Its incidence is rising worldwide, and T2DM is a leading cause of end-stage renal disease (ESRD) as well as a major risk factor for cardiovascular events. Early identification of patients at greatest risk and timely initiation of renal and cardiovascular protective interventions are therefore crucial.

Diabetic nephropathy is a significant complication of diabetes, typically progressing from normal albuminuria to microalbuminuria, overt proteinuria, and ultimately ESRD. The level of glycemic control is considered the dominant factor influencing the development of microalbuminuria. Microalbuminuria, defined as a urinary albumin excretion rate of 20–200 µg/min on timed specimens or an albumin-to-creatinine ratio (ACR) of 2.5–25 mg/mmol in males and 3.5–35 mg/mmol in females, serves as an early marker of renal damage and a predictor of progression to overt proteinuria and cardiovascular complications [5,6]. In patients with T2DM, hypertension and declining renal function may occur even when albumin excretion remains within the microalbuminuria range.

With increasing age, diabetes mellitus and nephropathy prevalence rises, affecting approximately 10% of individuals aged 65 years and above. Menopause, defined as the permanent cessation of menstruation for at least 12 months in women who have a uterus and are not pregnant or lactating, is associated with hormonal changes that can influence blood glucose control [7]. Women spend nearly one-third of their lives in postmenopause due to increased life expectancy [8]. Metabolic changes during menopause are influenced not only by hormonal fluctuations but also by aging itself [9].

The diagnosis of diabetes has traditionally been based on fasting blood glucose (FBG) or the oral glucose tolerance test (OGTT). In 1997, the Expert Committee revised diagnostic criteria, emphasizing FBG as a routine screening tool, with a threshold of ≥7 mmol/L, while the two-hour OGTT threshold remained >11.1 mmol/L [10]. Previously, HbA1c was not recommended for diagnosis due to assay variability; however, the International Expert Committee (2009) and the ADA (2010) now endorse HbA1c ≥6.5% as a diagnostic criterion, using standardized methods [3,11]. Despite the availability of multiple tests, consensus on the most accurate screening method is lacking, with FBG sensitivity limited, leaving nearly one-third of diabetic individuals undetected [12].
Minimizing microalbuminuria and maintaining tight glycemic control are essential therapeutic goals for patients with diabetes. In resource-limited settings such as Bangladesh, testing for microalbuminuria and HbA1c should be implemented for both newly diagnosed and existing T2DM patients to identify early renal risk.

The primary objective of this study is to evaluate the correlation between microalbuminuria, glycemic control, and other renal function parameters in postmenopausal women with type 2 diabetes.

Objective

- To evaluate the association between microalbuminuria, HbA1c levels, and renal function parameters in postmenopausal women with type 2 diabetes at DMCH.

Methods & 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 attending the endocrine outpatient department of Dhaka Medical College Hospital were included. Participants were selected using purposive sampling according to predefined inclusion and exclusion criteria to evaluate the relationship of microalbuminuria with HbA1c and other renal function parameters.

Inclusion Criteria

- Postmenopausal women with diagnosed 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 Considerations

Ethical clearance was obtained from the Ethical Review Committee of Dhaka Medical College. Written informed consent was obtained from all participants prior to inclusion in the study.

Study Variables and Definitions

The study variables included fasting plasma glucose, HbA1c, serum albumin, serum creatinine, urinary creatinine, microalbuminuria, and albumin–creatinine ratio (ACR). Postmenopause was defined as the permanent cessation of menstruation due to loss of ovarian follicular function, diagnosed retrospectively after 12 months of amenorrhea (Kumar and Malhotra, 2008; Manson and Bassuk, 2012).

Sample Collection and Preservation

After overnight fasting (≥12 hours), 10 mL of venous blood was collected aseptically from each participant. Three milliliters were placed in a tube containing EDTA and sodium fluoride for plasma analysis, and 7 mL in a plain tube for serum. Samples were allowed to clot, centrifuged at 3000 rpm for 10 minutes, and the serum and plasma were separated. Samples were either analyzed immediately or stored at –20°C until further analysis. A 5 mL morning urine sample was collected after at least 15 minutes of rest, divided into separate tubes for albumin and creatinine estimation, and analyzed promptly.

Laboratory Investigations

Biochemical parameters were measured according to standard reference ranges: fasting plasma glucose (4.2–6.2 mmol/L), HbA1c (<6.5%), serum albumin (3.5–5.58 g/dL), serum creatinine (0.55–1.02 mg/dL), urinary creatinine (11–20 mg/kg/day), microalbuminuria (<20 μg/min), and ACR (>30 μg/mg of urine creatinine).

Data Collection and Analysis

Participants were evaluated through history-taking, physical examination, and review of diabetes records from the endocrine department. Laboratory results were recorded in a pre-designed data collection sheet. Data were analyzed using SPSS version 21. Continuous variables were expressed as mean ± standard deviation. Differences between microalbuminuria-positive and -negative groups were compared using the unpaired t-test, and Pearson's correlation test was applied to assess relationships between variables. A p-value <0.05 was considered statistically significant at a 95% confidence interval.

RESULTS

Table – I: Distribution of Microalbuminuria Among Postmenopausal Women With Type 2 Diabetes Mellitus (*n* = 100)

Microalbuminuria status	Number of patients	Percentage (%)
Positive (MA +)	78	78.0
Negative (MA –)	22	22.0
Total	100	100.0

A total of 78% of the participants were found to have positive microalbuminuria.

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Table – II: Distribution of Microalbuminuria in Relation to Duration of Diabetes Mellitus in Postmenopausal Women With Type 2 Diabetes (*n* = 100)

Duration of Diabetes Mellitus	Total (n)	MA Positive (n = 78) [%]	MA Negative (n = 22) [%]	P Value
>5 years	65	65 (100)	0 (0.0)	
<5 years	35	13 (37.1)	22 (62.9)	
Total	100	78	22	
Mean ± SD		6.85 ± 1.85	3.91 ± 0.87	0.001

A total of 65 postmenopausal women had diabetes for more than 5 years, and all of them (100%) were positive for microalbuminuria.

Table – III: Distribution of Microalbuminuria in Relation to Serum Albumin Levels in Postmenopausal Women With Type 2 Diabetes (*n* = 100)

Serum Albumin (g/dL)	Total (n)	MA Positive (n = 78) [%]	MA Negative (n = 22) [%]	P Value
Normal (3.5–5.5 g/dL)	28	10 (35.7)	18 (64.3)	
<3.5 or >5.5 g/dL	72	68 (94.4)	4 (5.6)	
Total	100	78	22	
Mean ± SD		2.69 ± 0.71	3.90 ± 0.52	0.001

A total of 72 patients had hypoalbuminemia, among which 68 patients (94.4%) were positive for microalbuminuria.

Table – IV: Correlation of Microalbuminuria With Glycemic Status and Other Renal Parameters in Postmenopausal Women With Type 2 Diabetes (*n* = 100)

Parameter	Pearson Correlation (r)	P Value
Serum Albumin (g/dL)	–0.750	0.001
Urinary Creatinine	–0.762	0.001
Albumin-Creatinine Ratio (ACR)	0.997	0.001
HbA1c (%)	0.75	0.001
Fasting Blood Sugar (mg/dL)	0.717	0.001
Serum Creatinine (mg/dL)	0.694	0.001

Pearson's correlation coefficient (r) was used to assess the relationship between microalbuminuria and other variables. A p-value < 0.05 was considered statistically significant.

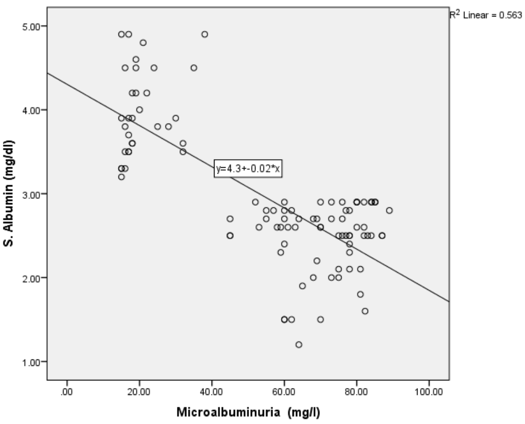

Figure – 1: Scatter Diagram Showing the Correlation Between Microalbuminuria and Serum Albumin in Postmenopausal Women With Type 2 Diabetes

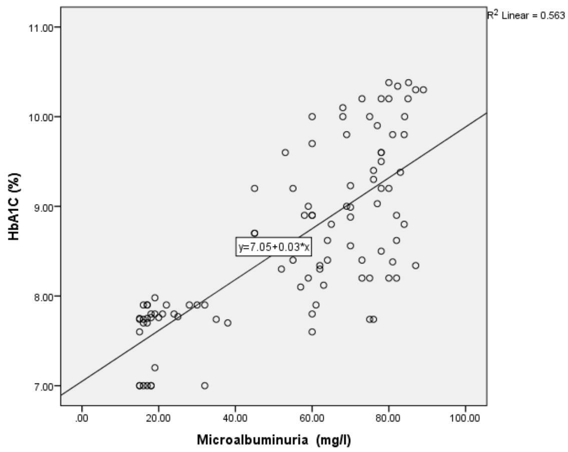

Figure – 2: Scatter Diagram Showing the Correlation Between Microalbuminuria and HbA1c in Postmenopausal Women With Type 2 Diabetes

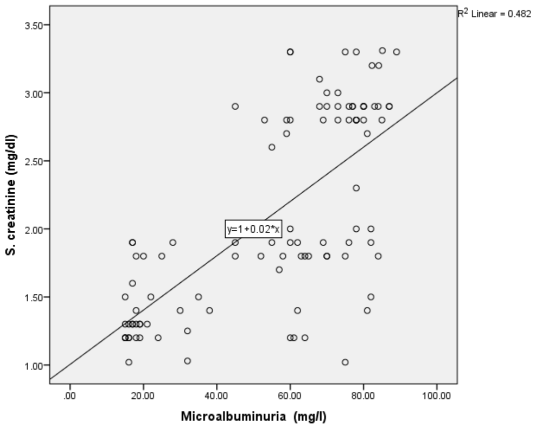

Figure – 3: Scatter Diagram Showing the Correlation Between Microalbuminuria and Serum Creatinine in Postmenopausal Women With Type 2 Diabetes

DISCUSSION

In this study, among 100 diabetic postmenopausal women, microalbuminuria was detected in 78 cases (78%). Several previous studies have evaluated the prevalence of microalbuminuria in diabetic patients, with reported rates varying from 61% in the UAE (Al-Maskari et al.)[6] to 37% in Korea (Park et al.)[13]. This variation may be attributed to differences in study design (community-based versus hospital-based), patient characteristics, urine sample collection methods, and the testing techniques used.

Al-Maskari et al.[6] conducted a study on 513 diabetic patients with a mean age of 53 years, randomly selected during 2003–2004. Microalbuminuria was found in 61% of the sample, and the rate was significantly higher among males. This finding differs from our study, which focused exclusively on postmenopausal women.

Park et al.[13] investigated the incidence and determinants of microalbuminuria in Korean patients with type 2 diabetes mellitus. Of the 146 patients who completed the study, 37 exhibited persistently elevated urinary albumin excretion during follow-up. The mean values of fasting plasma glucose, HbA1c, and duration of diabetes were significantly higher in patients with microalbuminuria, which correlates with our findings.

The present study also demonstrated that the prevalence of microalbuminuria increases with longer duration of diabetes. Sixty-five patients had diabetes for more than five years. A similar result was reported by Korah et al.[14] in a study conducted in the Internal Medicine Outpatient Department of Menoufiya University. They examined 60 diabetic patients (33 men and 27 women) who underwent medical and laboratory assessments including FBG, HbA1c, and ACR. However, they found no significant difference between women with normoalbuminuria and microalbuminuria with regard to fasting blood glucose, which differs from our findings. The duration of diabetes was significantly longer among men with microalbuminuria than among those without, whereas no significant difference was observed between the female groups — a result that also contrasts with our study. These discrepancies may be due to differences in diagnostic criteria, disease stage, assessment methods, and ethnicity.

Blood glucose is a dynamic variable that fluctuates approximately two-fold throughout the day in individuals without diabetes and up to ten-fold in those with diabetes. Earlier studies have suggested that glycosylated hemoglobin (HbA1c) can be used as a diagnostic test for type 2 diabetes, rather than relying solely on fasting blood glucose (Saudek et al.)[15]. In the present study, microalbuminuria showed a highly significant correlation with both fasting blood sugar (FBS) and HbA1c ($p < 0.001$), consistent with the findings of Kassab et al.[16]. The complications of both type 1 and type 2 diabetes do not develop or progress for 6–9 years when the average HbA1c level is maintained below 7% (Brownlee et al.)[17].

Microalbuminuria is associated with hyperglycemia, and strict control of blood glucose levels has been shown to prevent the development of nephropathy in both type 1 and type 2 diabetes.

Serum creatinine concentration is widely used clinically as an indicator of renal function, though it is influenced by factors such as age and sex. Microalbuminuria and serum creatinine were both found to increase significantly in patients with type 2 diabetes, as reported in an earlier study by Justesen et al.[18]. Similarly, our study demonstrated a highly significant correlation between microalbuminuria and serum creatinine levels ($p < 0.001$). Serum creatinine measurement remains a convenient and cost-effective method for assessing renal function, and persistently elevated levels suggest chronic kidney disease (Hebert et al.)[19].

In this study, there was a strong positive correlation between microalbuminuria and ACR, HbA1c, FBS, and serum creatinine, and a strong negative correlation between microalbuminuria and serum albumin as well as urinary creatinine. Hypoalbuminemia was observed in 72 women, among whom 68 were positive for microalbuminuria.

A rapid decline in renal function can be anticipated in patients with poor glycemic control and microalbuminuria. Therefore, minimizing microalbuminuria and maintaining tight glycemic control are essential treatment goals for diabetic patients.

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 on only a single occasion.
- The study included only hospital-based patients, so the study population may not represent the entire community.
- The sample size was small due to a short time frame and cost considerations; therefore, it may not adequately represent the total population, and a larger sample size could have provided more robust results.

Conclusion

This study demonstrates that microalbuminuria is not uncommon in diabetic postmenopausal women in Bangladesh. Early screening of patients with diabetes for microalbuminuria, along with prompt management of positive cases, may help reduce the burden of chronic kidney disease. We conclude that screening for albuminuria could be useful for early risk assessment and the prevention of diabetic complications in postmenopausal women in Bangladesh.

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