Original Article

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Association of Microalbuminuria with Glycemic Control among Type-2 Diabetes Patients: A Cross-Sectional Study

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ABSTRACT

Background: *Type 2 diabetes mellitus has been on the peak and a major cause of death due it's complications in recent years. Diabetic patients with microalbuminuria are at increased risk of microvascular and macrovascular complications. Also, microalbuminuria is considered as a leading indicator of diabetic nephropathy. Poor glycemic control accelerates kidney damage, increasing the risk of end-stage renal disease. Identifying the relationship between glycemic control and microalbuminuria is crucial for early intervention and prevention of renal complications. The study aimed to investigate the association of microalbuminuria with glycemic control among type-2 diabetes patients in a regional tertiary hospital in Chattogram, Bangladesh.*

Materials and methods: *This cross-sectional study was conducted in Department of Medicine, Endocrinology and Biochemistry in Chittagong Medical College, Chattogram from July 2022 to June 2023 among 119 people. The data were collected with face-to-face interview and HbA1c, UACR, BMI and WC were measured. The data were compiled and tabulated according to key variables and analyzed with IBM SPSS 29.0.2.*

Results: *The mean age of the patients was 57.2 ± 9.7 years and there was a male predominance (67.2%) in the study. 50.4% had generalized obesity and 69.7% had central obesity. 83.2% had poor glycemic status and 41.2% patients had microalbuminuria. The proportion of microalbuminuria was higher in T2DM patients with uncontrolled glycemic status. Duration of diabetes and glycemic status were significantly associated with microalbuminuria.*

Conclusion: *The study revealed that, frequency of microalbuminuria among type 2 diabetes is increasing in this contemporary era. Poor glycemic control is significantly associated with microalbuminuria in T2DM patients, emphasizing the need for screening of glucose markers and stringent glycemic management to prevent diabetic complications.*

Key words: Glycemic status; Microalbuminuria; Type-2-diabetes.

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Introduction

The prevalence of type 2 Diabetes Mellitus (T2DM) is recognized as a serious public health concern with its increasing prevalence worldwide.[1] It is a metabolic disorder characterized by the disruption of complex protein metabolism, leading to both macrovascular and microvascular complications.[2] Among these complications, diabetic nephropathy is one of the most common causes of chronic kidney disease (CKD) which remains the main cause of end-stage renal disease and premature mortality in diabetic patients.[3,4] The American Diabetic Association (ADA) recommends screening for microalbuminuria once a year for diabetic patients.[5] DM is highly prevalent in Bangladesh and the prevalence of T2DM became more than double compared to the 1995-2010 period.[6] In Bangladesh, 8.4 million adults lived with diabetes and projected to be almost double (15.0 million) by 2045.[7] Prevalence of diabetic nephropathy is 30.5% among them 21.1% had micro-albuminuria.[8] The overall prevalence of microalbuminuria among type 2 diabetic patients was 43.07% in Bangladesh.[9]

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Early identification of microalbuminuria allows for targeted therapeutic strategies, such as glycemic control to slow the progression of diabetic nephropathy. However, it differs between developing and developed countries due to delayed diagnosis, limited screening and diagnostic facilities, poor glycemic control and inadequate treatment of microalbuminuria.[10] Limited data are available on frequency of microalbuminuria in T2DM patients in Bangladesh and its correlation with the glycemic status of the patients. Moreover, Identifying the prevalence of microalbuminuria and its association with glycemic control inBangladeshmay provide valuable insights regarding T2D management. Which is necessary to explore for preventing early renal dysfunction and highlight the importance of proactive screening and management strategies to mitigate long-term renal consequences. This study aimed to evaluate the frequency of microalbuminuria in T2DM patients, the patient characteristics and evaluating the relationship between microalbuminuria and glycemic control.

Materials and methods

It was a cross-sectional descriptive type of observational study, conducted at the Department of Medicine, Endocrinology and Biochemistry in Chittagong Medical College, Chattogram during July 2022 to June 2023.

Diabetic patients with good glycemic control, with either gender having age in the range of 30 -72 years, were enrolled in the study.Patients with type 1 diabetes mellitus, urinary tract infection, urinary tract tumor, hematuria, congestive heart failure, current pregnancy, vaginal discharge and any recent self-reported illness or fever were excluded from the study. A sample size of 119 patients of type 2 DM was selected with convenient sampling technique.

Measurements

Microalbuminuria: MA is defined as excretion of 30–300 mg of albumin per 24 hours (or 20–200 mcg/min or 30–300 mcg/mg creatinine) on 2 of 3 urine collections.[11]

Anthropometric measurements: Participant's anthropometric measurements were taken including height, weight and waist circumference. BMI was calculated using weight in kg and height in m^2 and considered as underweight if below 18.5kg/m^2, normal weight at 18.5-24.9kg/m^2, overweight at 25-29.9kg/m^2 and obese at over 30.0kg/m^2 (WHO). The waist circumference for men >90cm and for women >80cm was considered as central obesity (WHO).

Biochemical measurements: Based on HbA1c values, the glycemic control was categorized into good control (≤7.0 %) and poor control (>7.0 %) (American Diabetic Association- ADA). Urinary albumin was measured with an autoanalyzer using Randox kits. A second 24-hour urine sample was obtained and examined for microalbuminuria if the first measurement exceeded 30 mg of albumin. The diagnosis of micro albuminuria was confirmed when >30 mg/dl albumin was found in the second sample. 24-hours urinary albumin concentration of <30 mg was considered as normal (Normo-albuminuria), 30-300 mg as microalbuminuria and > 300 mg as microalbuminuria (Overt proteinuria).[12]

For collecting data onpersonal and health information, a predesigned case record form was used. Collecting data by interview, medical records and laboratory investigation using a structured questionnaire. Additionally, venous blood was collected after 12 hours of fasting in a test tube with Ethylene Diamine Tetra-Acetic Acid (EDTA) anticoagulant forHbA1c. 24-hour urine was collected for the estimation of MA. HbA1c is estimated by High-Performance Liquid Chromatography (HPLC). After collection, the data were checked for discrepancies and compiled for analysis.

Data were analyzed using SPSS-31. Qualitative variables were analyzed using Chi-square tests and continuous variables with independent t-tests. Pearson correlation assessed relationships between quantitative variables. Associations between risk factors of microalbuminuria were analyzed using logistic regression. Results were expressed as Odds Ratio (OR) with 95% Confidence Interval (CI) of OR and $p < 0.05$ was considered statistically significant.

Patients fulfilling selection criteria were included in the study with their informed consent. Ethical clarification and approval were taken from Institutional Review Board (IRB) of Chittagong Medical College (Memo No – 59.27.0000.013.19.PG.2023.009/921).

Results

Table I Demographic characteristics of the patients (n=119)

Variables	Frequency	Percentage (%)
Age, in years (Mean±SD)	57.2 ± 9.7	
Gender		
Male	80	67.2
Female	39	32.8
Education		
No formal education	24	20.2
Primary or equivalent	35	29.4
Secondary or equivalent	17	14.3
Higher secondary or equivalent	17	14.3
Graduate and above	26	21.8

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This study comprises of 119 T2DM patients. The mean age of the patients was 57.2 ± 9.7 years and there was a male predominance (67.2%) in the study. Around half of the patients had primary and no formal education (29.4% and 20.2% respectively) followed by 21.8% of graduate or above education status.

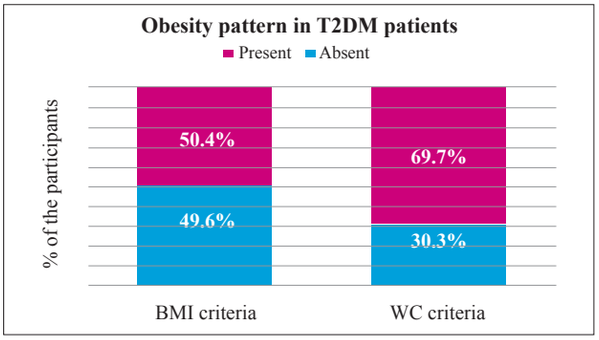

Figure 1 Generalized and central obesity in T2DM patients (n=119)

As per BMI criteria 50.4% had generalized obesity and 49.6% had normal BMI. According to WC criteria 69.7% had central obesity and 30.3% had normal WC.

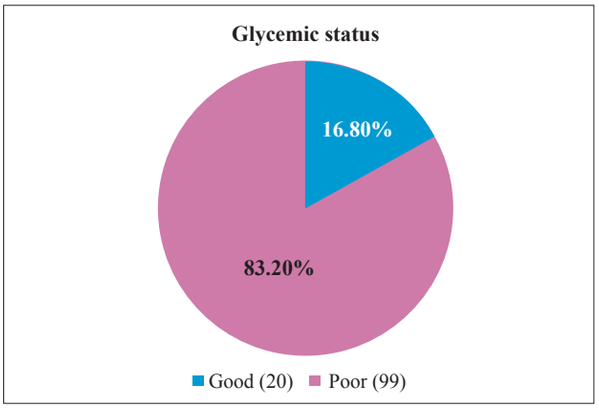

Figure 2 Glycemic status of the studied patients (n=119)

Most of the T2DM patients (83.2%) had poor glycemic status and only 16.8% had good glycemic status.

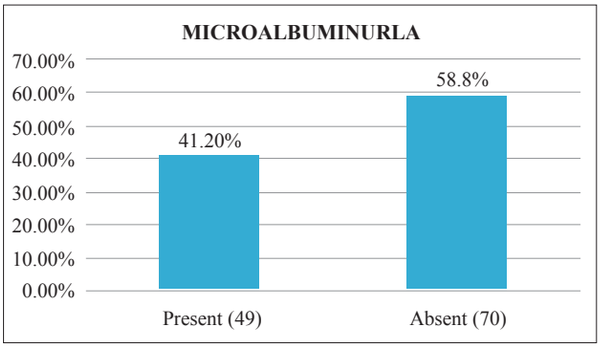

Figure 3 Microalbuminuria of the studied patients (n=119)

Among 119 T2DM patients 41.2% patients had microalbuminuria and 58.8% patient were without MA.

Table II Association of obesity and glycemic status with microalbuminuria in T2DM patients (n=119)

Variables		Microalbuminuria			
		Absent n (%)	Present n (%)	Total	p value
Obesity	**By BMI criteria**				
	Non-obese	33 (47.1%)	26 (53.1%)	59	0.525
	Obese	37 (52.9%)	23 (46.9%)	60	
	By WC criteria				
	Non-obese	20 (28.6%)	16 (32.7%)	36	0.633
	Obese	50 (71.4%)	33 (67.3%)	83	
Glycemic status	Controlled	18 (25.7%)	2 (4.1%)	20	0.002*
	Uncontrolled	52 (74.3%)	47 (95.9%)	99	

Among generalized obese patients 46.9% had microalbuminuria with p-value 0.525 and 67.3% patients had microalbuminuria who had central obesity with p-value 0.633. According to p-value there is no significant association between obesity (Either by BMI category or by WC category) and microalbuminuria (p>0.05). The proportion of microalbuminuria was higher in T2DM patients with uncontrolled glycemic status than the patients with good glycemic status (95.9% versus 4.1%), and the difference was significant statistically (p=0.002).

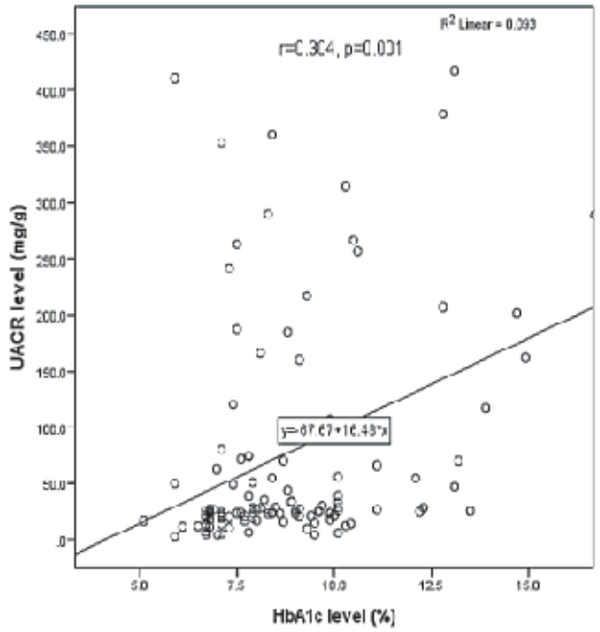

Figure IV Scatter dot plot showing correlation between HbA1c level and Urine Albumin Creatinine Ratio (UACR) level

However, there was a weak positive correlation between HbA1c level and UACR level in this study (Pearson correlation coefficient = 0.304) and the correlation was statistically significant (p=0.001).

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Table III Multivariate analysis of factors associated with microalbuminuria in T2DM patients (n=119)

Variables	B	p value	OR	95% CI for OR	
				Lower	Upper
Age (Years)	0.007	0.765	1.007	0.962	1.054
Gender	0.589	0.182	1.802	0.758	4.280
Duration of diabetes, years	0.086	0.010*	1.089	1.021	1.163
Uncontrolled glycemic status	1.968	0.013*	7.153	1.512	33.85

In the multivariate analysis of factors associated with microalbuminuria, two factors were statistically and significantly associated with microalbuminuria- one is duration of diabetes (p-value = 0.010) and other glycemic status (p-value = 0.013). T2DM patients with poor glycemic status was 7.15 times more likely to have microalbuminuria than the diabetic patients with good glycemic control (OR:7.15, 95% CI:1.51-33.85) (Table III). The findings of the study are summarized in the Figure 4, Table II and III.

Discussion

This cross-sectional study was conducted to assess the frequency of microalbuminuria in type-2 diabetes and its relation to glycemic status.In this study, it is found that, mean age of the patients was 57.2 years with a standard deviation of ±9.7 years. Among all the patients 80 (67.2%) were male and 39 (32.8%) were female. A similar study held in Islamabad which showed that the mean age of the type 2 diabetes patients was 40 years with SD ±12.56 years, among them56% patients were male and 44% were females.[13] Another study showed that males were at greater risk (65%) of developing type II diabetes mellitus in comparison to females (35%).[14]

In term of education, 24 (20.2%) had no formal education, 35 (29.4%) were primary equivalent, 17 (14.3%) were secondary equivalent, 17 (14.3 %) were HSC equivalent and only 26 (21.8%) were graduate or above (Table I). A study conducted in Bangladesh, revealed that 36.2% diabetic patients had no formal education, 35.7% had primary education and only 9.1% had higher educational status.[15]

Regarding weight status according to BMI, around half of the patients 60 (50.4%) were obese and according to WC, 83 (69.7%) had central obesity (Figure-1). A Bangladeshi study depicted that the largest-relative increase of diabetes type 2 (90%) was among obese individuals where logistic regression analysis identified high BMI was the key risk factor and adults who were overweight or obese were 1.54 times more likely to develop diabetes.[16]

Majority of the T2DM patients 99 (83.2%) had poor glycemic status and only (16.8%) had good glycemic status (Figure-2). A systemic review illustrated similar finding that, overall estimated prevalence of glycemic control among diabetic patients was 26.02%.[17]On contrary, another review showed that the prevalence of good glycemic status was 60% and poor glycemic status was 40% among type 2 diabetic patients.[18]

In the study, 49 (41.2%) patients had microalbuminuria while maximum patients 70 (58.8%) did not have (Figure-3). Similarly, a study conducted in Nepal mentioned that, microalbuminuria was found in 18.45% patients with type 2 diabetes and in other study of Pakistan microalbuminuria was accounting for 33.5% of the study population.[19,2] Another study showed that among 165 enrolled cases, 89 (54%) type-2 diabetic patients were normoalbuminuric, 53 (32%) Microalbuminuria and 14% macroalbuminuria.[14]

Regarding thecorrelation between HbA1c level and UACR level, there was a weak positive correlation between HbA1c level and UACR level in this study (Pearson correlation coefficient = 0.304) and the correlation was statistically significant (p=0.001) (Figure-3). A study from Pakistan revealed that 46 (27.9%) type-2 diabetic cases with microalbuminuria represent raised HbA1C levels at 95% CI.[14]

Among generalized obese patients 23 (46.9%) had microalbuminuria with p-value 0.525 and 33 (67.3%) patients had microalbuminuria who had central obesity (p-value 0.633). According to Table II, there is no significant association between obesity and microalbuminuria (p>0.05).A study in USA investigated that, type 2 diabetic patients with highest quartile of BMI (OR 1.72) and WC (OR 1.75) had significant association with microalbuminuria compared with the lowest quartile.[20]

In case of association between glycemic status and microalbuminuria, the proportion of microalbuminuria was higher 47 (95.9%) in T2DM patients with uncontrolled glycemic status than the patients with good glycemic status 2 (4.1%) and the difference was significant statistically (p=0.002) (Table II). A study held in USA also showed alike findings: diabetic patients with poor glycemic control and good glycemic control had the frequency of microalbuminuria of 35.9% and 10%, respectively.[21] Another study in Saudi Arabia revealed that, HbA1c was significantly higher in patients with microalbuminuria (9.3 ± 2.2, p 0.001).[22]

In present study, two factors were statistically and significantly associated with microalbuminuria- one is duration of diabetes and other glycemic status (p-value 0.010 and 0.013 respectively) (Table III). T2DM patients with poor glycemic status was 7.15 times more likely to have microalbuminuria than the diabetic

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patients with good glycemic control (OR:7.15, 95% CI:1.51-33.85). On the other hand, age and gender had no significant association with microalbuminuria according to the multivariate analysis of factors in (Table III).

Limitations

The study was conducted to fulfill an academic purpose. There was no funding allocated for the study. Thestudy had small sample size due to budget constrain. Moreover, the patients were selected from a regional tertiary hospital. As a result, the study population might not represent the whole community. Another limitation is due to a cross-sectional design that could not explain the causal relationships between the variables and no chance for follow-up. Data were collected through the self-reported information from the participants and serum for biochemical information which lacked the gold standard (24-hour urine test) for measuring albuminuria which may interfere the outcomes.

Conclusion

The frequency of microalbuminuria among T2DM patients is relatively high (Two in every five diabetic patients had microalbuminuria) and the association between glycemic status and microalbuminuria was statistically significant. Therefore, screening for both glucose markers (HbA1c and microalbuminuria)are essential for intervention and prevention of DKD. Not only screening but also regular check pattern and strict glycemic management are indeed necessary to prevent DM-related complications.

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Disclosure

The authors declare no conflict of interest.

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