Original Research Article

The Prevalence of Microalbuinuria & Associated Risk Factors at The Time of Diagnosis Among Type 2 Diabetic Patients in Rajshahi City, Bangladesh

Abstract

Background: The presence of albumin in the urine is a marker of glomerular involvement in type 2 diabetes mellitus (T2DM), depicting diabetic nephropathy. Strict glycemic control can prevent and delay the occurrence of microalbuminuria and other diabetic complications. Therefore, this study evaluated the prevalence of microalbuinuria & associated risk factors at the timi e of diagnosis among type 2 diabetic patients in Rajshahi city.

Methods: Between January 2019 and December 2019, a cross-sectional analytical study was collaboratively undertaken by the Department of Physiology at Rajshahi Medical College and the Diabetic Association Hospital in Rajshahi. Following an initial evaluation, patients underwent an oral glucose tolerance test (OGTT) for a conclusive diagnosis of DM. Subsequently, subjects were subjected to rigorous screening procedures based on specific inclusion and exclusion criteria. Study group A consisted of 80 diabetic subjects, while an equivalent number of age- and gender-matched non-diabetic individuals were recruited for study group B, with participants drawn from hospital staff, patients' relatives, and volunteers, resulting in a total of 80 participants in each group.

Results: The study findings showed that among the healthy adult group, 85% had normal fasting blood sugar (FBS), while 15% had impaired fasting sugar (IFG). Conversely, in the diabetic group, none had normal FBS or IFG. The mean urine microalbumin level was significantly higher in the diabetic group (24.63±14.75 mg/day) compared to the control group (11.59±5.41 mg/day), indicating abnormal levels in about one-third of diabetic respondents versus none in the healthy group. Additionally, all healthy adults had normal urine spot microalbumin levels, whereas 25 diabetic respondents exceeded normal levels.

Conclusion: Newly diagnosed diabetic patients showed higher levels of urine microalbumin compared to healthy adults, suggesting potential early markers for diabetic nephropathy. However, further large-scale prospective studies are required to confirm their clinical usefulness for routine screening.

Keywords: Type 2 diabetes, chronic kidney diseases (CKD), microalbumin

Introduction

Diabetes is a metabolic condition characterized by excessive glucose synthesis, decreased insulin secretion, and insulin resistance. One of the leading causes of death and disability is type 2 diabetes mellitus. Although cardiovascular disease is the leading cause of morbidity and death in people with diabetes, microvascular complications such as renal disease and retinopathy are common and contribute considerably to the total disease burden. Notably, about 30–40% of people with type 2 diabetes have abnormal urine albumin levels, and the presence of renal disease increases the risk of death from cardiovascular disease. Microalbuminuria, a precursor to diabetic nephropathy, increases the risk of cardiovascular disease on its own. There may be more than simply renal microvascular injury going on when there is an increase in urine albumin secretion. [1-3]

Over the past decade, the incidence of end-stage renal disease has surged, primarily attributed to the increased prevalence of diabetes. The early phase following the onset of diabetes mellitus is marked by glomerular hyperperfusion and renal hypertrophy, reflected in an elevated glomerular filtration rate. Within the initial five years of diabetes, the glomerular filtration rate normalizes. However, after 5–10 years in type 1 diabetes mellitus, 40% of individuals begin to excrete small amounts of albumin in their urine (microalbuminuria). Microalbuminuria is defined as 30 to 300 mg/d in a 24-hour collection or 30 to 300 µg/mg creatinine in a spot collection. Its emergence in type 1 diabetes mellitus serves as a significant predictor of progressing to overt proteinuria (>300 mg/d), with 50% of these cases culminating in end-stage renal disease within 7–10 years. In contrast, type 2 diabetes mellitus may present with microalbuminuria or overt nephropathy at the time of diagnosis, often accompanied by hypertension. [2] [3] Notably, albuminuria in type 2 diabetes mellitus may stem from factors unrelated to diabetes, such as hypertension, congestive heart failure, prostate disease, or infection. Microalbuminuria in diabetes mellitus heightens the risk of cardiovascular disease. [4]

The presence of microalbumin in the urine of type 2 diabetes patients is a crucial early indicator signaling the onset of systemic vasculopathy and associated organ damage, particularly affecting the brain, heart, and kidneys. Microalbuminuria also serves as a marker

for patients necessitating more rigorous cardiovascular risk management, including intensive blood pressure control, meticulous glycemic control, and lipid level monitoring.[5][6]

The kidney's fundamental role involves excreting low molecular weight, water-soluble plasma waste products into the urine while retaining larger macromolecules like albumin. Recent hypotheses suggest that microalbuminuria leading to proteinuria and end-stage renal disease primarily results from an altered glomerular filtration barrier at the podocyte level. [7] [8] Nevertheless, arterial hypertension and abnormalities in blood lipid concentrations and structure are also significant precursors to these complications in diabetes mellitus. Notably, hyperglycemia, arterial hypertension, and dyslipidemia may cause disturbances in the albumin excretion rate by damaging podocytes and the slit diaphragm protein scaffold, leading to overproduction and extracellular release of oxygen radical species at the glomerular level. [9]

In this study our main goal was to evaluate prevalence of microalbuinuria & associated risk factors at the time of diagnosis among type 2 diabetic patients in Rajshahi city. The study on the "Prevalence of Microalbuminuria & Associated Risk Factors at the Time of Diagnosis Among Type 2 Diabetic Patients" holds significant importance due to its potential to transform clinical practice and public health. Early detection of microalbuminuria in newly diagnosed Type 2 diabetic patients is vital for timely intervention to prevent or slow the progression of kidney disease, a severe complication of diabetes. By identifying the risk factors associated with microalbuminuria, such as hypertension and poor glycemic control, the study provides valuable insights for targeted interventions. This research contributes to improved patient outcomes, preservation of renal function, and a better quality of life. Moreover, it informs healthcare resource allocation, aids in the development of preventive measures, and has broader public health implications by addressing the global challenges of diabetes and its complications.

Methodology

Study Design: This was a cross-sectional analytical study conducted between January 2019 and December 2019 in collaboration between the Department of Physiology at Rajshahi Medical College and the Diabetic Association Hospital in Rajshahi.

Study Population: The primary objective was to investigate diabetes mellitus (DM) within the patient population attending the hospital's outpatient department (OPD) who presented clinical symptoms suggestive of DM. Patients with clinical suspicion underwent an oral

glucose tolerance test (OGTT) for DM confirmation.

Inclusion and Exclusion Criteria: Subjects were meticulously screened based on specific inclusion and exclusion criteria. The study comprised two groups, Group A (80 diabetic subjects), and Group B (80 non-diabetic subjects matched for age and sex, including hospital staff, patients' relatives, and volunteers), with participants selected through consecutive purposive sampling.

Data Collection: The study gathered an array of demographic and medical information, including age, gender, disease duration, social and economic status, educational background, medical history, and treatment regimen. Urinary albumin concentration was determined using random morning spot urine samples, and blood sugar levels were quantified using the GOD–POD method. The estimated glomerular filtration rate (e-GFR) was calculated using the Cockroft-Gault formula. Data were meticulously recorded in a pre-designed case record form by the researcher.

Data Analysis: Following data collection, statistical analysis was conducted using SPSS software. The data underwent thorough consistency checks, and normality was assessed using the Kolmogorov–Smirnov test. Continuous variables were presented as mean ± standard deviation, while qualitative variables were expressed as frequencies and proportions. For normally distributed data, Student's t-test was utilized to compare means between two groups, and the Mann–Whitney test was applied for skewed data. Proportions were compared employing the Chi-square or Fisher's exact test, as deemed appropriate.

Results

Table-1 illustrates a nearly identical distribution of age within the group of healthy adults. The mean age for newly diagnosed DM patients was 53.05±8.14 years, while the healthy adult group had a mean age of 52.16±7.25 years. In totality, the respondents had an average age of 52.61±7.70 years. Remarkably, there were no statistically significant differences in age between the two groups (P >.05), and the disparities in mean age were similarly not significant (P >0.05). Furthermore, it is worth noting that in both the group of newly diagnosed DM patients and the healthy adult cohort, females were more predominant, accounting for 63.8% and 56.3% respectively, while males constituted 36.3% and 44.7%

respectively.

Table-1: Age and Gender Distribution of the patients (n=160)

Age (In years)	DM (n=80) No. (%)	Healthy adults (n=80) No. (%)	Total (n=160) No. (%)	p-value
40-49	31 (38.75)	32 (40.00)	63 (39.40)	**0.921**
50-59	33 (41.25)	34(42.50)	67 (41.90)	
>60	16 (20.00)	14 (17.50)	30 (18.80)	
Mean	53.05±8.14	52.16±7.25	52.61±7.70	**0.468**
Gender				
Male	29 (36.3%)	35 (44.7%)	64 (40%)	
Female	**51 (63.8%)**	**45 (56.3%)**	**96 (60%)**	

Table-2 shows the fasting blood sugar distribution between the two groups. It reveals that, in healthy adult group most of the respondents (85%) had normal fasting blood sugar & 15% had IFG (impaired fasting sugar). None of the respondents in DM group had normal FBS or IFG. A Chi square test for independence with $\alpha=0.05$ was used to assess fasting blood sugar level between the two groups. The relation between the two groups was statistically significant (p=0.00).

Table-2: Distribution of the respondents according to fasting blood sugar among the respondents (n=160)

FBS catagory		Group		Total
		DM	HA	
Normal or abnormal FBS	Normal	0(0.0%)	68(85.0%)	**68(42.50 %)**
	IFG	0(0.0%)	12(15.0%)	**12(7.5%)**

	DM	80(100%)	0(0%)	**80 (50.0%)**
Total		**80 (100.0%)**	**80 (100.0%)**	**160(100.0 %)**

Table-3 shows Distribution of the respondents on the basis of urine microalbumin level. Mean urine microalbumin level was statistically significantly higher in case group than control group (p<0.001). In case group the mean urine microalbumin level was 24.63±14.75 mg/day and in control group mean urine microalbumin level was 11.59±5.41 mg/day. Number of subjects having increased urine microalbumin level was also statistically significantly higher in case group than control group (p<0.001). In case group 25 (31.25%) patients had urine microalbumin level above normal range (<30mg/day) and in control group all subjects had normal urine microalbumin level.

Table-3: Distribution of the respondents on the basis of urine microalbumin level

Variable		Case (n=80) No. (%)	Control (n=80) No. (%)	Total (n=160) No. (%)	P value
Urine microalbumin level	**Normal**	55 (68.75)	80 (100)	135 (84.38)	**<0.001**
	Above normal	25 (31.25)	00 (00)	09 (15.63)	
Mean urine microalbumin (mg/day)		**24.63±14.75**	**11.59±5.41**	**18.11±12.86**	**0.00**

Figure-1 shows age wise distribution of microalbuminuria in diabetic patients where majority of the case and control group were belonging to 50-59 years age group.

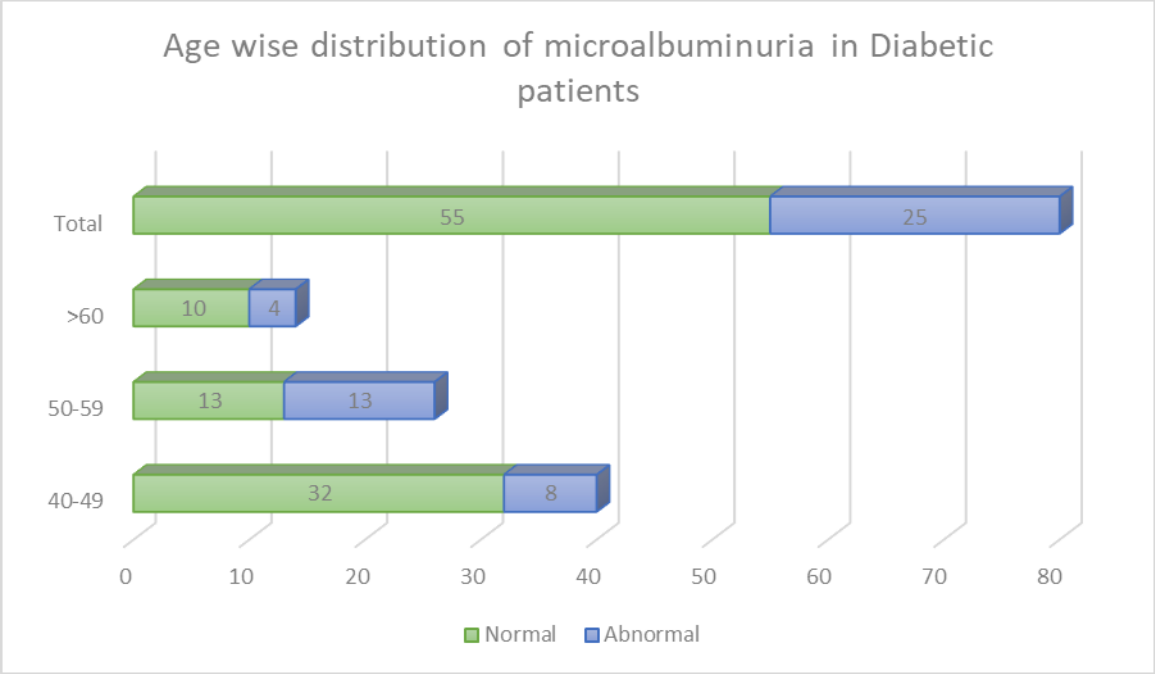

Figure 1-: Age wise distribution of microalbuminuria in diabetic patients

Table-4 shows the relationship of spot urine microalbumin level and fasting blood sugar level. It reveals that, in healthy adult group all of the respondents had normal microalbumin level, whereas in diabetic group about 1/3rd of the respondents have abnormal urine microalbumin level. A chi square test for independence with α=0.05 was used to assess urine microalbumin level between the groups. The relation between the groups was statistically significant (p=0.00).

Table-4: Distribution of respondents with urine microalbumin in relation with fasting blood sugar

		Spot urine microalbumin condition		Total
		Normal	Above normal	
Normal or abnormal FBS	**Normal**	68(100.0%)	0(0.0%)	**68(100.0%)**
	IFG	12(100.0%)	0(0.0%)	**12(100.0%)**

	DM	55(69.1%)	25(30.9%)	**80(100.0%)**
Total		**135(84.4%)**	**25(15.6%)**	**160(100.0%)**

Pearson χ^2=28.89, df=2, p=0.000

Table 5 showed the relationship between 2 hours after blood sugar and spot urine microalbumin level. It revealed that, in healthy adult group all the respondents had normal urine spot microalbumin level whereas, in diabetic group 25 respondents had above normal. A chi square test for independence with α=0.05 was used to assess urine microalbumin level between the groups. The relation between the groups was statistically significant (χ2=30.380, df=2, p=0.00)

Table-5: Distribution of respondents with urine microalbumin in relation with Post prandial blood sugar

Post Prandial Blood Sugar		**Spot urine microalbumin condition**		**Total**
		Normal	**Above normal**	
Normal or IGT or Dm	**Normal**	68(100.0%)	0(0.0%)	68(100.0%)
	IGT	13(100.0%)	0(0.0%)	13(100.0%)

	DM	54(68.4%)	25(31.6%)	79(100.0%)
Total		135(84.4%)	25(15.6%)	160(100.0%)

Pearson χ^2=30.380, df=2, p=0.000

Table-6 shows Distribution of the respondents on the basis of eGFR. Mean eGFR was statistically significantly lower in case group than control group (p=0.009). In case group the mean eGFR was 95.63±17.84 ml/min and in control group mean eGFR was 100.65±13.52 ml/min. Number of subjects having decreased eGFR was also statistically significantly higher (p<0.05) in diabetic group than heathy adult group (p=0.046). In case group 19 (23.75%) patients had eGFR below normal range (90 ml/min) and in control group only 07 (8.75%) subjects had eGFR below normal level.

Table 6 : Distribution of the respondents on the basis of eGFR

Variable		DM (n=80) No. (%)	Healthy adults (n=80) No. (%)	Total (n=160) No. (%)	P value
eGFR level	**Normal**	61 (76.25)	73 (91.25)	134 (83.75)	**0.010**
	Below normal	19 (23.75)	07 (8.75)	26 (6.25)	

Mean eGFR (ml/min)	**95.63±17.84**	**100.65±13.52**	**98.14±15.98**	**0.046**

Chi-squared Test ($\square^2$)was performed to compare between two groups Unpaired t-test was performed to compare the mean between the groups Pearson $\square^2$=6.613, df=1, p=0.010

Table showed the distribution of eGFR between the respondents which revealed that only 1 respondent had severe CKD who was in diabetic group. Respondents with eGFR is more in healthy adult group than that of diabetic group. Mild CKD was proportionately higher in diabetic than healthy adults (15 vs 6 respectively). A chi square test for independence with α=0.05 was used to assess whether stage of assess whether stage of CKD on the basis of eGFR between DM & HA groups. The relation between the two groups were not statistically significant ($\chi2$=0.693, df=3, p value>0.05).

Table 7: Distribution of the respondents: CKD staging on the basis of eGFR

eGFR based CKD staging		**Group**		**Total**
		DM	HA	
Stage of CKD	Normal	61 (45.5%)	73 (54.5%)	**134 (100.0%)**
	Mild	15 (71.4%)	6 (28.6%)	**21 (100.0%)**
	Mild to moderate	3 (75.0%)	1 (25.0%)	**4 (100.0%)**
	Moderate to severe	1 (100.0%)	0 (0.0%)	**1 (100.0%)**
Total		**80 (50.0%)**	**80 (50.0%)**	**160 (100.0%)**

Pearson χ^2= 6.932, df= 3, p=0.7

Discussion

There were three times as many cases of urine microalbumin levels in the sick group as in the healthy group (p=0.014, 0.017, and <0.001). In the group of people with diabetes, 31.25% had higher levels of microalbumin in their pee, while in the group of healthy adults, only 15.63% had higher levels. Among the diabetic cases 23.75% had below normal eGFR and in healthy adult group 6.25% had below normal eGFR. Study conducted by Vansawala and associates observed below normal eGFR among their 23% diabetic cases which is nearly consistent to the finding of this study. [10]

Agarwal and associates observed urine microalbumin level among their 17.34% of their newly diagnosed type 2 diabetes mellitus cases while Patel and co-researchers observed increased urine micro-albumin among their 43% of their newly diagnosed type 2 diabetes cases. [11-12]

Genetic factors,metabolic dysregulation like hyperglycemia, hyperlipidemia, hemodynamic modification, activation of protein kinase C, increased production of glycosylation end products, extracellular matrix point deposition at the glomerular level, thus inducing mesangial expansion and glomerular basement membrane thickening are the key mechanism of nephropathy in diabetic patients. [13-15]

Fasting blood glucose (95% CI P=0:0017) levels were significantly associated with microalbuminuria. In this study, in diabetic group about 1/3 rd of the respondents have abnormal urine microalbumin level which was also statistically significant (p=0.00).

A study done by Rachel J. Middleton, Robert N. Foley in Sulford, UK showed that 27.5% of the population with diabetes have clinically significant CKD, as defined by an eGFR<60ml/min/1.73m 2. [16-17] This is consistent with this study. In this study number of subjects having decreased eGFR was also statistically significantly higher in diabetic group than heathy adult group (p=0.046).

According to a study reported that, among 455 diabetic respondents, 30% had normal eGFR, 52% had mild CKD, 14% had mild to moderate CKD , 3.1% had moderate to severe CKD, .04% had severe CKD. [17] There was no statistical significance between decreased GFR between the diabetic and non diabetic group. [18, 17] In this study, 76.25% of the diabetic respondents had normal eGFR, 18% had mild, 3.75% had mild to moderate CKD, 1.25% had

moderate to severe CKD, none of the diabetic respondents had severe CKD. There was no statistically significant relationship between diabetic and healthy adult group on the basis of CKD in this study. This is consistent with this study.

Conclusion

Diabetic nephropathy is a severe complication occurring in diabetic patients and it is associated with an increased risk of all-cause mortality, cardiovascular disease and progression to end stage renal disease (ESRD), requiring costly renal replacement therapy in the form of dialysis or transplantation. The decline in kidney function varies considerably between individuals but determinants of renal function loss, early in the course of renal disease, have not been clearly

identified. This study had assessed proportion of renal dysfunction among the diabetic and healthy adult group by urine microalbumin and eGFR level. Microalbuminuria has been accepted as the earliest marker for diabetic nephropathy. This study observed urine microalbumin was higher and there was significant mean difference in newly diagnosed diabetic patients than that of healthy adult group. Despite the promise of these biomarkers, further large, multicenter prospective studies are still needed to confirm their clinical utility as a screening tool for every day practice.

Research Weaknesses

This study has several limitations that should be acknowledged. First, the sample size was relatively small, potentially limiting the generalizability of the findings. A larger and more diverse sample would have provided increased statistical power. Second, the cross-sectional design employed in this study impedes the establishment of causal relationships between variables; future research employing longitudinal or experimental designs may offer a more robust understanding of the phenomena under investigation. Additionally, the consecutive purposive sampling approach may introduce selection bias. Finally, data collection methods, including self-reported information and laboratory measurements, may have introduced measurement errors and biases, influencing the study's outcomes.

Acknowledgment

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collaborative efforts. Special thanks go to the dedicated research team and data collectors whose commitment was instrumental in executing this study.

Competing Interest

The authors declare no competing interests related to this research. The study was conducted without external funding or financial support that could have influenced its design, data collection, analysis, or interpretation. Its sole purpose was to advance scientific knowledge and enhance healthcare outcomes.

Ethical Approval:

As per international standard or university standards written ethical approval has been collected and preserved by the author(s).

Consent: All participants provided formal informed written consent after receiving comprehensive explanations of the study's title, objectives, procedures, potential benefits, and associated risks. Participation was voluntary, without financial incentives, and did not interfere with regular medical care. The importance of data confidentiality was emphasized, and participants were informed of their right to discontinue their participation at any time.

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