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Association of Microalbuminuria and Renal Function Tests Parameters in Type 2 Diabetes Mellitus

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ABSTRACT https://doi.org/10.3126/njhs.v5i1.86100

Introduction: Type 2 diabetes mellitus, a metabolic disorder with an increasing global prevalence frequently results in chronic complications like diabetic nephropathy. Microalbuminuria is an early indicator of renal damage and glycemic factors are important for managing diabetes mellitus.

Objective: This study was carried to find out the urinary microalbumin and renal function test parameters in type 2 diabetes mellitus patients.

Methods: An analytical cross-sectional study was conducted over four months (March to June 2025) at the National Medical College. A total of 300 T2 diabetes mellitus patients were enrolled. Data on FBS, PPBS, HbA_1C, serum urea, creatinine, sodium, potassium, and urinary microalbumin were collected and analyzed using SPSS 22. Pearson's correlation, independent t-test, Smirnov Kolmogorov test and Mann Whitney U test, were applied where appropriate, with $p<0.05$ considered statistically significant.

Results: Poor glycemic control was evident with mean FBS of 193.36 ± 74.86 mg/dL, PPBS of 305.70 ± 87.78 mg/dL, and HbA_1C of 8.48 ± 1.84%. Renal function parameters showed elevated urea (66.45 ± 58.39 mg/dL) and creatinine (2.04 ± 1.39 mg/dL). Microalbuminuria was present in 23% and macroalbuminuria in another 13.3% of patients. Strong positive correlations were found between microalbumin and serum urea (r=0.67), creatinine (r=0.62), HbA_1C (r=0.17), FBS (r=0.24), PPBS (r=0.21) potassium (r=0.49), and a negative correlation with sodium (r= -0.39) all of which were statistically significant ($p < 0.01$).

Conclusions: The study concluded there is a significant association of urinary microalbuminuria and persistent proteinuria as well as derangements in the parameters of renal function test in the type 2 diabetic patients.

Keywords: Diabetes mellitus; microalbuminuria; nephropathy; renal parameters.

INTRODUCTION

High blood glucose levels and abnormalities in metabolism are hallmarks of Diabetes Mellitus (DM), a common metabolic disease.[1] By 2030, the global prevalence of DM is expected to increase to 4.4%.

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Diabetic Nephropathy (DN) is a chronic microvascular consequence of DM. Therefore, it is essential to look into the underlying mechanisms and consider efficient management techniques for DN.[1] Among the different parameters for evaluation DM; glycated hemoglobin (HbA_1C) is the gold standard.[2] The urinary excretion of 30–300 mg of albumin per day is referred to as microalbuminuria, which is a stage in between normal albumin levels and macroalbuminuria (>300 mg/day).[3,4] Overt proteinuria, a crucial indicator of diabetic ephropathy, is defined as albumin excretion over 300 mg/day. In clinical terms, microalbuminuria is followed by proteinuria.[5] Diabetes is a leading cause of end-stage renal disease and diabetic nephropathy, also known as diabetic kidney disease. Serum creatinine is a more reliable indicator of changes in glomerular filtration rate (GFR) than urea.[6] Chronic renal problems can result from uncontrolled DM. Blood urea and serum creatinine levels are elevated in those with positive microalbuminuria.[7,8] The study aims to assess the diabetic profile, renal function parameters, and microalbuminuria in individuals with type 2 diabetes mellitus.

METHODS

The current study was analytical cross sectional study which was undertaken in the Outpatients and Inpatient Department of NMCTH, Birgunj, Parsa, Madhesh Province, Nepal. Three hundred (300) type 2 diabetic patients were enrolled for the study within the study duration period of four months (March 2025 to June 2025). The informed written consent was taken from the patients before enrolling into our study. Probability sampling technique was used for the sample collection. The study variables for the study were Fasting Blood sugar,

postprandial blood sugar, HbA_1C, Serum Creatinine, Urea, Sodium, potassium and Microalbumin in 24h urine, Age and Gender. Fully automated clinical chemistry analyzer (Beckmann Coulter AU 480), ISE (Ion selective electrode) (SENSA CORE ST 200 PRO analyzer), Getein 11000 (Immunofluorescence quantitative analyzer) was used to measure the renal profile and the sugar profile in the patient's serum. The statistical tools MS Excel version 10 and Statistical Package for Social Science (SPSS) version 22 was used for the analysis and interpretation of the data. Ethical clearance was obtained from Institutional Review Committee (IRC), National Medical College and Teaching Hospital, Birgunj, Nepal before starting the research (Ref no: F-NMC/710/080-081).

The sample size was calculation by using this formula n = z^2pq/ e^2

Where, z = 1.96

p = prevalence 26% [8]

q =1- p = 74%

e = 0.05 (allowable error 5%)

= 1.96^2 x 0.26 x 0.74 / $(0.05)^2$

= 295.65

= ~296

Inclusion criteria includes only diagnosed cases of Type 2 Diabetes Mellitus patients attending the inpatient and outpatient department of Biochemistry in National Medical College and Teaching Hospital whereas exclusion criteria involves those patients who are not willing to participate in our study were excluded from our study. All the data were entered in Microsoft Excel 2010 and converted to SPSS version 22 accordingly. The normality of the data was checked using Smirnov Kolmogorov test. Frequency and Mean was calculated for descriptive statistics. Independent t-test was used to compare the mean between the two groups for the parametric data. Continuous data are expressed as mean and SD. Non parametric data were compared using Mann Whitney U test. Pearson's correlation was applied to parametric data. Statistical significance was set at $p < 0.05$.

RESULTS

The mean age of the participants was 54.01 ± 14.64 years. The mean values for key Fasting Blood Sugar (FBS), Postprandial Blood Sugar (PPBS), and HbA1C were 193.36 ± 74.86 mg/dL, 305.70 ± 87.78 mg/dL, and HbA_1C was 8.48 ± 1.84%, respectively, indicating poor glycemic control. The renal function parameters showed a mean urea level of 66.45 ± 58.39 mg/dL, creatinine of 2.04 ± 1.39 mg/dL, sodium of 137.60 ± 5.10 mEq/L, and potassium of 4.85 ± 0.92 mEq/L. The median and interquartile ranges of urinary microalbumin level was 24 (6, 50) mg/24 h, suggesting a wide variation among patients (Table 1).

Table 1: Descriptive analysis of variables in diabetic patients.

S.N.	Variables	Frequency (n)	Mean ± SD
1	Age (years)	300	54.01 ± 14.64
2	FBS (mg/dL)	300	193.36 ± 74.86
3	PPBS (mg/dL)	300	305.70 ± 87.78
4	HbA_1C (%)	300	8.48 ± 1.84
5	Urea (mg/dL)	300	66.45 ± 58.39
6	Creatinine (mg/dL)	300	2.04 ± 1.39
7	Sodium (mEq/L)	300	137.60 ± 5.10
8	Potassium (mEq/L)	300	4.85 ± 0.92
9	Microalbumin (mg/24 hours)	300	24 (6,50)

When comparing male (59.67%) and female (40.33%) patients, no statistically significant differences were observed in any of the studied variables, including age, glycemic profile, renal function markers, and microalbumin levels (all $p > 0.05$) (Table 2).

Figure 1 shows the distribution of patients based on albuminuria. The majority of the patients (63.7%) had normal microalbumin levels (less than 30 mg/24 hours), 23% had microalbuminuria (between 30 and 300 mg/24 hours), and 13.3% had macroalbuminuria (more than 300 mg/24 hours).

Table 2: Comparison of variables between male and female.

S.N.	Variables	Gender		p value*
		Male	Female	
1	Age (years)	54.10 ± 13.62	53.88 ± 16.09	0.90
2	FBS (mg/dL)	193.49 ± 74.54	193.17 ± 75.64	0.97
3	PPBS (mg/dL)	308.02 ± 89.84	302.26±84.89	0.57
4	HbA_1C (%)	8.53±1.93	8.41±1.69	0.56
5	Urea (mg/dL)	65.58±53.87	67.74±64.72	0.31
6	Creatinine (mg/dL)	2.10±2.31	2.51±1.96	0.62
7	Sodium (mEq/L)	137.24 ± 5.11	138.14±5.07	0.13
8	Potassium (mEq/L)	4.89±0.912	4.78±0.95	0.35
9	Microalbumin (mg/24 hours)	24 (16,53)	23 (16,51)	0.72

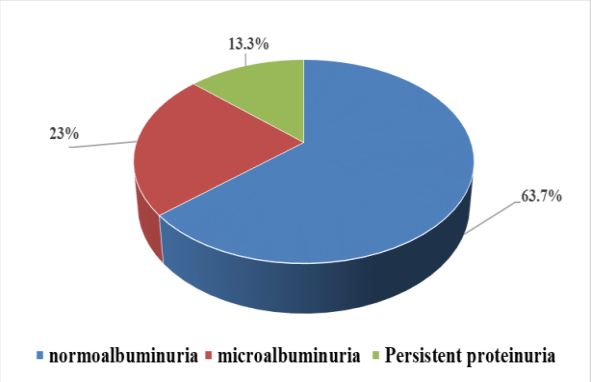

Figure 1: Distribution of patients based on albumin in urine (n=300).

Spearman's rho for the non-parametric correlation analysis revealed that urinary microalbumin had a strong positive correlation with urea ($r = 0.67$, $p < 0.01$) and creatinine ($r = 0.62$, $p < 0.01$). There was also a moderate positive correlation with potassium ($r = 0.49$, $p < 0.01$) and a moderate negative correlation with sodium ($r = -0.39$, $p < 0.01$). Additionally, microalbumin was weakly but significantly correlated with postprandial blood glucose ($r = 0.21$, $p = 0.01$) and age ($r = 0.42$, $p < 0.01$). Moreover, significant correlation was found between microalbumin and FBS (0.24, <0.01) & HbA_1C levels (0.17, <0.01) (Table 3).

Table 3: Correlation analysis of microalbumin with diabetic profile and renal function test parameters.

S.No.	Variables	Correlation coefficient (r)	p value*
1	Age (years)	0.42	<0.01**
2	Fasting blood glucose (mg/dL)	0.24	<0.01**
3	Post prandial blood glucose (mg/dL)	0.21	<0.01**
4	HbA_1C (%)	0.17	<0.01**
5	Urea (mg/dL)	0.67	<0.01**
6	Creatinine (mg/dL)	0.62	<0.01**
7	Na^+(mEq/L)	-0.39	<0.01**
8	K^+ (mEq/L)	0.49	<0.01**

**** Correlation is significant at 0.01 level (two tailed)**
*** Correlation is significant at 0.05 level (two tailed)**

DISCUSSIONS

Diabetes mellitus, particularly type 2 diabetes mellitus, is a chronic metabolic disorder characterized by persistent hyperglycemia and dysregulation of carbohydrate, fat, and protein metabolism. Over time, sustained high blood sugar inflicts damage on small blood vessels, leading to serious microvascular complications, most notably diabetic nephropathy, which is a leading cause of chronic kidney disease and end-stage renal failure.[9]

In the current study, which involved 300 participants, a 23% prevalence of microalbuminuria was observed. This finding is in agreement with a study conducted in Pokhara, Nepal shown 45.5% prevalence of microalbuminuria.[10] Another study conducted in Bangladesh reported 29.72 % prevalence of microalbuminuria in T2DM patients.[11] Similar to our findings, another study revealed microalbuminuria in 44.6% of patients with T2DM. They also highlighted the duration of T2DM, nephropathy, and estimated glomerular filtration rate.[15] The significant burden of albuminuria among our patients signifies the need for early screening and intervention to prevent irreversible renal damage.

Our study revealed no statistically significant differences between male and female patients across all biochemical variables. Age was positively correlated with urinary microalbumin. This suggests that renal complications become more prominent as diabetes progresses with age. Similar findings have been obtained in population-based studies, indicating that both age and duration of diabetes are important risk factors for diabetic nephropathy.[5] Strong positive correlations were found between microalbumin and serum urea ($r = 0.67$) and creatinine ($r = 0.62$), both of which were statistically significant ($p < 0.01$). These findings align with previous research indicating that elevated microalbumin levels are associated with declining glomerular filtration rates and worsening kidney function.[8] These markers are widely used to monitor renal status, and their correlation with albuminuria reinforces the interrelated pathophysiology of diabetic nephropathy.

Our study also revealed the positive correlation of urinary microalbumin with glycated hemoglobin which was statistically significant. In agreement to our study, a study by Acharya K et al. at Institute of Medicine revealed a positive correlation of microalbumin with glycated hemoglobin. In their study the prevalence of microalbuminuria was 39.6% .[13]

In our study, a 23% prevalence of microalbuminuria was observed among 300 participants. Additionally, 63.7% had normoalbuminuria, while 13.3% presented with persistent proteinuria. These findings are in accordance with a study conducted in Biratnagar, Nepal, which reported a 26% prevalence of microalbuminuria, 60% of diabetic patients with normal microalbumin levels, and 14% with proteinuria. Furthermore, the Biratnagar study also demonstrated that renal function parameters, such as serum creatinine and blood urea levels, were elevated in patients with positive

microalbuminuria.[8] The study by Eerike M. et al. reveals significant electrolyte imbalances in patients with T2DM, characterized by reduced sodium levels and elevated potassium levels compared to healthy controls. These alterations are closely associated with poor glycemic control and longer disease duration. Our study also revealed that urinary microalbumin had a strong positive correlation with serum potassium and a negative correlation with serum sodium, suggesting a link between renal dysfunction and electrolyte disturbances in T2DM patients.[14]

In a study conducted by Kare S et al. involving patients with type 2 diabetes mellitus, both microalbuminuria and glycemic control exhibited a statistically significant linear correlation with the duration of diabetes ($p < 0.05$). Additionally, microalbuminuria showed a significant negative correlation with increasing levels of glycosylated hemoglobin (HbA_1c), suggesting that poorer glycemic control is associated with greater degrees of microalbuminuria. In our study, Pearson's correlation analysis revealed that urinary microalbumin was significantly correlated with postprandial blood glucose ($r = 0.21$, $p = 0.01$) and also significant correlation was found between microalbumin, FBS and HbA_1C levels.[15]

CONCLUSIONS

The study concluded that there is a significant association of urinary microalbuminuria and persistent proteinuria as well as derangements in the parameters of renal function test in the type 2 diabetic patients. These findings reinforce the importance of regular screening for microalbuminuria and renal function markers in patients with diabetes mellitus. It also conveys the fact that early detection of albuminuria is the need for early diagnosis of diabetic nephropathy.

Conflicts of interest: None

REFERENCES

1. Zhao W, Li X, Liu X, Lu L, Gao Z. Thyroid function in patients with type 2 diabetes mellitus and diabetic nephropathy: a single center study. Journal of thyroid research. 2018;2018(1):9507028. [PubMed | Full Text | DOI]
2. Ketema EB, Kibret KT. Correlation of fasting and postprandial plasma glucose with HbA1c in assessing glycemic control; systematic review and meta-analysis. Archives of Public Health. 2015 Sep 25;73(1):43. [PubMed | Full Text | DOI]
3. Sheth JJ. Diabetes, microalbuminuria and hypertension. Clinical and experimental hypertension. 1999 Jan 1;21(1-2):61-8. [PubMed | Full Text | DOI]
4. U.Satyanarayn, U.Chakrapani. Insulin, glucose homeostasis and diabetes mellitus (Ch-36), text book of Biochemistry. 3(2009); 684.
5. Inomata S, Nakamoto Y, Inoue M, Itoh M, Ohsawa Y, Masamune O. Relationship between urinary albumin excretion rate and renal histology in non-insulin-dependent diabetes mellitus: with reference to the clinical significance of microalbuminuria. Journal of Diabetic Complications. 1989 Jul 1;3(3):172-8. [PubMed | Full Text | DOI]
6. Lin Y, Xu Y, Chen G, Huang B, Chen Z, Yao L, Chen Z. Glycated hemoglobin, diabetes mellitus, and cardiovascular risk in a cross-sectional study among She Chinese population. Journal of Endocrinological Investigation. 2012 Jan;35(1):35-41. [PubMed | Full Text | DOI]
7. Gregg EW, Li Y, Wang J, Rios Burrows N, Ali MK, Rolka D, Williams DE, Geiss L. Changes in diabetes-related complications in the United States, 1990–2010. New England Journal of Medicine. 2014 Apr 17;370(16):1514-23. [PubMed | Full Text | DOI]
8. Shah PK, Shreewastav RK, Singh AG. Study of Renal Profile in Diabetic Patient at Nobel Medical College Teaching Hospital, Biratnagar. Journal of Nobel Medical College. 2016 Dec 26;5(2):1-4. [PubMed | Full Text | DOI]
9. Koroshi A. Microalbuminuria, is it so important?. Hippokratia. 2007 Jul;11(3):105.
10. Sigdel M, Rajbhandari N, Basnet S, Nagila A, Basnet P, Tamrakar BK. Microalbuminuria among type-2 diabetes mellitus patients in Pokhara, Nepal. Nepal Med Coll J. 2008 Dec 1;10(4):242-5. [PubMed | Full Text | DOI]
11. Asadujjaman M, Kashem A, Chowdhury AA, Roy AS, Muqueet MA, Fazilatunnasa M, Ahammed SU, Rabbani MG, Rahman MA, Kabir MS, Hossain MB. Prevalence of Microalbuminuria and Overt Proteinuria in Diabetes Mellitus and their Association with Renal Function. Mymensingh medical journal: MMJ. 2018 Jul 1;27(3):467-74. [PubMed | Full Text | DOI]
12. Acharya K, Regmi S, Sapkota AS, Raut M, Jha B. Microalbumin status in relation to glycated haemoglobin and duration of type 2 diabetes mellitus. Annals of Clinical Chemistry and Laboratory Medicine. 2015 Mar 19;1(1):21-4. [PubMed]
13. Pawar BG, Eerike M, Pyati AK, Varatharajan S, Mali K, Konda VG, Mali Sr K. Correlation of serum Electrolyte Imbalances with Diabetic Duration and Medication Use: a cross-sectional comparative study. Cureus. 2024 Sep 24;16(9). [PubMed]
14. Molefe-Baikai OJ, Molefi M, Cainelli F, Rwegerera GM. The prevalence of microalbuminuria and associated factors among patients with type 2 diabetes mellitus in Botswana. Nigerian journal of clinical practice. 2018;21(11):1430-7. [PubMed | Full Text | DOI]
15. Kare S, Reddy VN, Mahamkali T. A study to assess the correlation between HbA1c and microalbuminuria among diabetics. International Journal of Advances in Medicine. 2021 Jan;8(1):16. [PubMed | Full Text | DOI]