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Correlation of Serum Urea, Creatinine and Urinary Microalbumin in Type 2 Diabetic Patients in Western, Nepal: A Cross Sectional Study

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ABSTRACT

Introduction: Diabetic mellitus (DM) is a group of metabolic disorders where glucose is underused, producing hyperglycemia, which is associated with renal dysfunction. Abnormal renal function is indicated by an abnormality in various biochemical parameters, among them serum urea, creatinine, and urinary microalbumin. In diabetic mellitus, these mentioned markers are usually correlated with the severity of kidney damage.
Objective: The objectives of the studies were to compare the level and direction of urea, microalbumin, and other study parameters such as creatinine and serum glucose among diabetic and non-diabetic individuals in Butwal, Nepal.
Materials and Method: This was a cross-sectional comparative study of type-2 diabetic and non-diabetic individuals who came to the National Path Lab (A-grade reference lab) in Butwal sub-metropolitan area, Rupandehi, for routine blood tests. A total of 100 samples were collected using the simple random sampling method, and study parameters were determined using standard laboratory protocols.
Results: Among the studied samples, 40 were diabetic and 60 were not. The mean SD of serum urea, creatinine, and urine microalbumin for diabetic patients was 53.50 7.68, 1.71 0.23, and 33.0 8.25, respectively, and 20.60 5.12, 0.73 0.19, and 11.73 4.517, respectively, for non-diabetic individuals. There were correlations between serum urea, creatinine, and urinary microalbumin among the diabetic patients. The r-values of urea, creatinine, and microalbumin were 0.703, 0.572, and 0.674, respectively. It is also statistically significant in diabetic and non-diabetic individuals (p-value 0.001) with serum urea, creatinine, and urinary microalbumin.
Conclusion: This study suggested that there were correlations between serum urea, creatinine, and urinary microalbumin in diabetic patients and a statistically insignificant relationship between urinary microalbumin and serum creatinine in diabetic and non-diabetic individuals among various age groups in the study population.

Keywords: Creatinine, Diabetes mellitus, Diabetic Nephropathy, Microalbumin, Urea

INTRODUCTION

Diabetes mellitus (DM) is a group of metabolic disorders of carbohydrate metabolism in which glucose is underused, producing hyperglycemia that is associated with absolute or relative deficiencies in

insulin secretion, insulin action, or both. [1, 2] The greatest increase in prevalence is occurring in low- and middle-income countries, including in Asia and Africa. [3] In nephrology, renal function is an indication of the kidney's condition and its role in renal physiology. [4, 5] Abnormal renal function is represented by an abnormality in serum creatinine and serum urea. [6, 7] The major markers used in diabetic patients are serum urea, serum creatinine, and urinary microalbumin. This study was conducted in order to establish the correlation between serum urea, serum creatinine, and urinary microalbumin in type 2 diabetics.

MATERIALS & METHODS

A cross-sectional comparative study was conducted at the National Path Lab, Butwal, Rupandehi, a reference laboratory certified by the National Public Health Laboratory (NPHL), Nepal. The study was conducted from October 2019 to November 2020. This study was approved by the Institutional Review Committee (IRC), Pokhara University Research Centre, Kaski, Nepal (Ref. No.: 117/075/76). Sample size calculation was done by using the formula: $n = \frac{Z^2 P(1-P)}{d^2}$ where n = sample size; Z = confidence level value of Z at 5% level of significance ($Z_{0.05}$ = 1.96); P = expected prevalence = 5.8% (Noncommunicable Disease Risk Factors: STEPS Survey Nepal 2019); d = margin of error = 5%; and 84 was found to be the sample size. Adding a non-response rate of 20%, we got a total sample size of 100.

A simple random sampling method was used for the sampling procedure. Concern Laboratory also gave their approval for this study. Patients with tuberculosis, rheumatoid arthritis, renal disease, and sepsis were excluded from the study. The test was done using a specific test method. For the urea and creatinine analyses, a fully automated dry chemistry analyzer (BA400 Biosystem) was used. For urinary microalbumin, the MISPA-i2 analyzer was used. Random blood sugar was measured by the glucose oxidase/peroxidase (GOD/POD) method. Serum urea and serum creatinine were measured by the photometry method. Midstream urine was taken, and urinary microalbumin was measured by the turbidimetric method. The data was analyzed using SPSS. In the descriptive analysis, frequency, percentage, and mean ± SD were calculated. The chi square test was used to test the mean values of urea, creatinine, and microalbumin among the diabetic and non-diabetic groups. Correlation was measured using Pearson's correlation coefficient.

RESULT

Out of the 100 samples, 40 were diabetic and 60 were non-diabetic, where 23 (57.50%) were male and 17 (42.50%) were female in diabetic patients, and 33 (55%) were male and 27 (45%) were female in non-diabetic patients. As shown in Figure 1, the males outnumbered the females in both diabetic and non-diabetic patients.

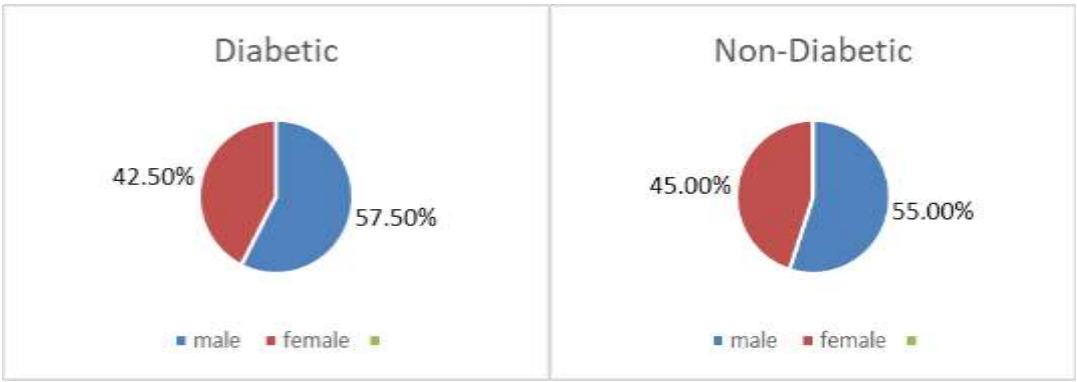

Fig.1: Gender wise distribution among diabetic and non-diabetic individual

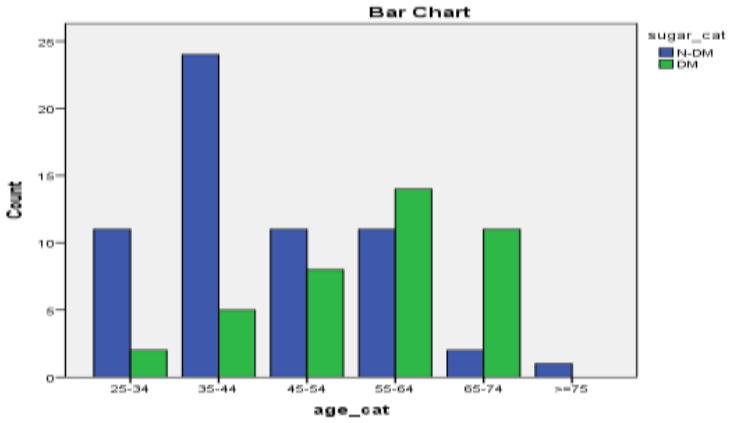

Fig. 2: Age-group distribution of diabetic and non-diabetic populations.

As shown in Figure 2, the majority of the patients were between the ages of 55 and 64 for diabetics and 35 and 44 for non-diabetics.

Table 1. Serum urea, creatinine, and urinary microalbumin in diabetic and non-diabetic individuals.

Parameters (mg/dl)	Group	Mean±SD	p-value
Urea	Diabetic	53.50±7.68	<0.001*
	Non-Diabetic	20.60±5.12	
Creatinine	Diabetic	1.71±0.23	<0.001*
	Non-Diabetic	0.73±0.19	
Microalbumin	Diabetic	33.0±8.25	<0.001*
	Non-Diabetic	11.73±4.517	

The mean ±SD of serum urea, serum creatinine, and urine microalbumin in this study was 53.50 ± 7.68, 1.71±0.23, and 33.0±8.25 respectively, for diabetic patients and 20.60±5.12, 0.73±0.19 and 11.73±4.517 for non-diabetic patients. It was concluded that urea, serum creatinine, and microalbumin were statistically significant in diabetic and non-diabetic individuals.

Table 2. Association of age with serum creatinine in diabetic and non-diabetic individuals

Age group (year)	Normal (0.5-1.3) mg/dl	High (≥ 1.4) mg/dl	Low (≤0.4) mg/dl	Total	p-value
Diabetic					
25-34	0	2	0	2	
35-44	1	4	0	5	
45-54	0	8	0	8	
55-64	0	14	0	14	0.127
65-74	0	11	0	11	
≥75	0	0	0	0	
Total	1	39	0	40	
Non-Diabetic					
25-34	11	0	0	11	
35-44	24	0	0	24	
45-54	11	0	0	11	
55-64	10	0	1	11	0.476
65-74	2	0	2	4	
≥75	1	0	0	1	
Total	59	0	1	60	

The creatinine levels were found to be higher among diabetic patients in the 55-64 age group. Whereas creatinine levels were found to be higher in non-diabetic patients aged 35-44 years. The Chi-square test was applied to test the association between the variables. It was found that there was no significant association between age and serum creatinine in diabetic and non-diabetic patients, respectively, as represented by Table 2. In Table 3, it was found that there was no significant association between genders and serum creatinine in diabetics and non-diabetics, respectively.

Table 3. Association of gender with serum creatinine in diabetic & non-diabetic individuals

Age group(year)	Normal (0-25) mg/l	High (≥ 25) mg/l	Low (>0.0) mg/l	Total	Age group (year)
Diabetic					
25-34	0	2	0	2	
35-44	1	4	0	5	
45-54	0	8	0	8	
55-64	0	14	0	14	0.127
65-74	0	11	0	11	
≥75	0	0	0	0	
Total	1	39	0	40	
Non-Diabetic					
25-34	11	0	0	11	
35-44	24	0	0	24	
45-54	11	0	0	11	
55-64	11	0	0	11	0.476
65-74	2	0	0	2	
≥75	1	0	0	1	
Total	60	0	0	60	

In table 3, it was also found that there was no significant association between genders and serum creatinine in diabetics and non-diabetics. In table 4, it was found that there was no significant association between genders and urine microalbumin in diabetics. The microalbumin levels were found to be higher among diabetic patients in the age group of 55–64 years.

Table 4. Association of age with urinary microalbumin in diabetic and non-diabetic populations

Diabetic					
		sugar (70-110 mg/dl)	**urea (15-40mg/dl)**	**creatinine (0.4-1.3mg/dl)**	**microalbumin (0-25mg/l)**
sugar (70-110 mg/dl)	Pearson Correlation	1	.703**	.572**	.674**
urea (15-40mg/dl)	Pearson Correlation	.703**	1	.793**	.578**
Creatinine (0.4-1.3mg/dl)	Pearson Correlation	.572**	.793**	1	.502**
microalbumin (0-25mg/l)	Pearson Correlation	.674**	.578**	.502**	1
**Correlation is significant at the 0.01 level (2-tailed).					

Diabetic					
		sugar (70-110 mg/dl)	**urea (15-40mg/dl)**	**creatinine (0.4-1.3mg/dl)**	**microalbumin (0-25mg/l)**
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Creatinine (0.4-1.3mg/dl)	Pearson Correlation	.572**	.793**	1	.502**
microalbumin (0-25mg/l)	Pearson Correlation	.674**	.578**	.502**	1
**Correlation is significant at the 0.01 level (2-tailed).					
Non-diabetic					
		sugar (70-110 mg/dl)	**urea (15-40mg/dl)**	**creatinine (0.4-1.3mg/dl)**	**microalbumin (0-25mg/l)**
sugar (70-110 mg/dl)	Pearson Correlation	1	.224	.286*	.389**
urea (15-40mg/dl)	Pearson Correlation	.224	1	.452**	.427**
Creatinine (0.4-1.3mg/dl)	Pearson Correlation	.286*	.452**	1	.206
microalbumin (0-25mg/l)	Pearson Correlation	.389**	.427**	.206	1

Non-diabetic					
		sugar (70-110 mg/dl)	**urea (15-40mg/dl)**	**creatinine (0.4-1.3mg/dl)**	**microalbumin (0-25mg/l)**
sugar (70-110 mg/dl)	Pearson Correlation	1	0.224	0.286*	0.389**
urea (15-40mg/dl)	Pearson Correlation	0.224	1	0.452**	0.427**
Creatinine (0.4-1.3mg/dl)	Pearson Correlation	0.286*	0.452**	1	0.206
microalbumin (0-25mg/l)	Pearson Correlation	0.389**	0.427**	0.206	1

In table 4, it was also found that there was no significant association between age and urine microalbumin in diabetic patients. The microalbumin level was found to be higher in non-diabetic patients aged 35–44 years. In table 5, it was found that there was no significant association between gender and urine microalbumin in diabetics and non-diabetics.

		Sugar (70-110 mg/dl)		Urea (15-40mg/dl)		Creatinine (0.4-1.3mg/dl)		Microalbumin (0-25mg/l)	
		Diabetic	Non-diabetic	Diabetic	Non-diabetic	Diabetic	Non-diabetic	Diabetic	Non-diabetic
Sugar (70-110 mg/dl)	Pearson Correlation	-	-	0.703**	0.224	0.572**	0.286*	0.674**	0.389*
	p-value			<0.0001	0.085	<0.0001	0.027	<0.0001	0.002
Urea (15-40mg/dl)	Pearson Correlation	0.703**	0.224	-	-	0.793**	0.452**	0.578**	0.427**
	p-value	<0.0001	0.085			<0.0001	<0.0001	<0.0001	0.001
Creatinine (0.4-1.3mg/dl)	Pearson Correlation	0.572**	0.286*	.793**	0.452**	-	-	0.502**	0.206
	p-value	<0.0001	0.027	<0.0001	<0.0001			<0.0001	0.115
Microalbumin (0-25mg/l)	Pearson Correlation	0.674**	0.389**	0.578**	0.427**	0.502**	0.206	-	-
	p-value	<0.0001	0.002	<0.0001	0.001	<0.0001	0.115		
		**Correlation is significant at the 0.01 level (2-tailed).							

Table 5. Association of gender with microalbumin in diabetic and non-diabetic patients

There were correlations between serum urea, serum creatinine, and urine microalbumin in diabetics. (Karl Pearson correlation coefficient, i.e. r-value of urea, creatinine, and microalbumin were 0.703, 0.572, and 0.674, respectively.) There was no correlation between serum urea, serum creatinine, and urine microalbumin in non-diabetics. (r-value of urea, creatinine, and microalbumin were 0.224, 0.286, and 0.389, respectively.)

DISCUSSION

Diabetes mellitus is a slow, progressive disease characterized by hyperglycemia. Few studies have correlated levels of serum creatinine, urea, and microalbumin with blood sugar levels in diabetic individuals.

In our study, the majority of patients were between the ages of 55 and 64 for diabetics and 35 and 44 for non-diabetics. In a study conducted by Sharlin *et al*., the number of type-2 diabetic patients was highest in the 50–54-year age group (17 patients, 34%) and lowest in the 40–44-year age group (8 patients, 16%) [8]. In our study, the mean ±SD of serum urea, creatinine, and microalbumin was 53.50 ± 7.68, 1.71±0.23, and 33.0±8.25 respectively, for diabetic patients and 20.60±5.12, 0.73±0.19, and 11.73±4.517 for non-diabetic patients. The result was obtained by Shrestha *et al.*, who reported that the mean ± SD urea level in the non-diabetic group was found to be 31± 9.04 whereas in the diabetic group it was found to be 38 ± 14.6. The mean ±SD creatinine levels in non-diabetic were found to be 0.76 ± 0.27, and in diabetic, it was found to be 0.95 ± 0.49 [9]. Also, a similar study done by Bamanikar *et al*., reported that the blood sugar and serum urea levels were found to be significant establishing a strong relationship between sugar level and urea level. However, the association between hyperglycemia and the serum creatinine levels showed a weaker link. [10] Shahid et al., also found no significant elevation in the mean value of serum creatinine was observed in diabetic patients without nephropathy when compared to non-diabetics. [11]

The study done by Bamaninkar *et al.* reported that the blood sugar and urine microalbumin were found to be significantly correlated, establishing a strong relationship between diabetes and microalbumin [12]. Similar to our study, there was another study done by Paving HH *et al.* that shows that there is a strong association between diabetes and microalbumin [13]

Research conducted by Anjaneyulu *et al.* had found that increased urea and serum creatinine in diabetic rats indicate progressive renal damage [14]. In our study, serum creatinine was not found to be significantly different between diabetic and non-diabetic patients. It could be because serum creatinine is a more sensitive indicator of kidney function than serum urea level. This is because creatinine fulfills most of the requirements for a perfect filtration

marker, which is also supported by the study done by Deepa *et al*., in India. [15]

In our study, the association of age with creatinine in diabetic and non-diabetic patients showed that creatinine was statistically insignificant. The relationship between age and creatinine levels supports the study of Cholongitas *et al.,* who reported that serum creatinine levels are influenced by age [16] Ashavaid *et al.* reported that high serum creatinine levels were seen in males more than females, which could be because of the presence of higher muscle mass in males compared to females. Schutte *et al.* found that there was no significant difference in the serum creatinine level of females between diabetic and non-diabetic females. [17]

CONCLUSION

The present study concludes that the correlations exist between serum urea, serum creatinine and urine microalbumin in diabetic patient. The serum creatinine and urinary microalbumin levels were found to be higher among the diabetic patients of age group 55-64 years whereas serum creatinine and urinary microalbumin levels were found to be higher among the non-diabetic patients of age group 35-44 years. This study has shown the statistically insignificant relationship of the degree of albuminuria and serum creatinine with age. Regular monitoring of the different parameters helps in early detection of diabetic militias and also provides reference to prevent the progression to end-stage renal disease.

Declaration by Authors

Ethical Approval: Approved (Reference no. 117/076/077) from Pokhara University Research Center, Pokhara, Nepal

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Conflict of Interest: The authors do not have any kind of competing interests.

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