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Prevalence of Diabetic Nephropathy in Patients with Type Two Diabetes Mellitus: A Cross-Sectional Study

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Abstract

Background and Objectives: Diabetic Nephropathy is the leading cause of end-stage renal disease worldwide, placing enormous pressure on healthcare systems and creating a heavy socioeconomic burden. It is urgent to comprehensively study the epidemiological characteristics of Diabetic Nephropathy in diabetic patients and to analyze the related factors to its incidence in order to implement effective prevention and control measures. The objective of the study is to identify the percentage of diabetic patients who developed nephropathy.

Methods: This cross-sectional study included 250 patients who visited Sulaymaniyah Endocrine and Diabetic Center from April 2023 to September 2023. The participants were sent for investigations, including urea, creatinine, urinary albumin-to-creatinine ratio, and Glycated hemoglobin. The estimated glomerular filtration rate was calculated by the Cockcroft-Gault equation.

Results: A total of 250 patients participated in the study; 147 were females and 103 were males. Additionally, 190 of the patients were from urban areas, and 60 from rural ones. The mean age of the participants was 59 ± 11.21 years old. Of the patients, 104 (41.60%) had only diabetes mellitus, while 146 (58.40%) had diabetes mellitus and another chronic illness. 81 (32.4%) of patients had Diabetic nephropathy; of them, 28.4% had microalbuminuria and 4% had macroalbuminuria. The highest prevalence of nephropathy was found in those patients who were over 65 years old, and the lowest frequency was seen in those less than 45 years old.

Conclusion: One-third of patients developed Diabetic nephropathy. Diabetic nephropathy was significantly affected by the duration of Diabetes Mellitus, older age, and other chronic illnesses; however, gender, residency, and Glycated hemoglobin level had no significant impact on the incidence of Diabetic nephropathy.

Keywords: Albuminuria, Diabetes Mellitus, Diabetic Nephropathy, Urinary Albumin-to-Creatinine Ratio

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Introduction

Chronic metabolic disease, known as diabetes mellitus, is now considered a serious global public health issue. The World Health Organization estimates that 422 million people worldwide had diabetes in 2014. By 2040, that number is expected to increase to roughly 642 million people, along with a rise in the complications related to the disease. Diabetic nephropathy (DN) is among the problems linked to diabetes.[1] Diabetic nephropathy is the most prevalent consequence of type 2 diabetes mellitus and the leading cause of end-stage renal failure globally. It is critical to identify patients who are more likely to acquire Diabetic nephropathy in order to properly manage the condition.[2] Early stages of the typical manifestation of diabetic kidney disease are marked by hyperfiltration and albuminuria, which are subsequently associated with a steady deterioration in renal function.[3] Every year for type 1 diabetes, commencing five years after diagnosis, and every year for type 2 diabetes, starting at diagnosis, screening for microalbuminuria (MA) should be carried out.[4] Numerous biochemical markers associated with Diabetic nephropathy have been discovered recently, and these markers are crucial for forecasting the onset and progression of illnesses. Urine is a perfect biological sample to find new kidney disease biomarkers because it is easy to collect non-invasively.[5] Quantitative techniques such as the following can be used to screen for microalbuminuria: first screen test: measuring the albumin-to-creatinine ratio in a random urine sample. The creatinine clearance can be measured simultaneously with a 24-hour urine collection. Second screen test: timed urine collection for protein over night or the use of semi-quantitative reagent dipsticks, like the Micral dipsticks, which are specifically made with detection limits appropriate for diagnosing microalbuminuria.[6] Consequently, diabetic nephropathy continues to be a major clinical challenge for the physicians throughout the world, in spite of advances in medical knowledge and investigations. Therefore, it is necessary to understand pathophysiologic mechanisms of diabetic nephropathy to inhibit deterioration of the disease and promote the development of potent and effective treatment approach for this devastating complication of Diabetes Mellitus.[3] The objective of the study is to know how many patients with Diabetes Mellitus have been affected by Diabetic nephropathy and to identify the contributing factors to its development.

Patients and methods

From April 2023 to September 2023, 250 randomly selected type two diabetes mellitus patients who were seen at the Sulaymaniyah Endocrine and Diabetic Center participated in a cross-sectional study. The following characteristics were gathered using a questionnaire that the research participants directly completed: age, sex, residency, length of diabetes mellitus, co-occurring conditions, and kind of diabetes treatment. Glycated hemoglobin, blood urea, serum creatinine, and the albumin-to-creatinine ratio in urine were all tested in the lab. Estimated glomerular filtration rate is computed by the Cockcroft-Gault formula. Early morning urine samples were used to calculate the urinary albumin-to-creatinine ratio. Any patient who had type 2 diabetes mellitus and was more than 18 years old met the inclusion requirements. Type one Diabetes Mellitus, critically ill patients, gestational diabetes mellitus, and interstitial renal disease were the exclusion criteria. Urinary Albumin-to-Creatinine Ratio between 30 and 300 mg/g is referred to as microalbuminuria, while urinary Albumin-to-Creatinine Ratio greater than 300 mg/g is referred to as macroalbuminuria. The Kurdistan Higher Council of Medical Specialties approved the study to ensure

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ethical standards, numbered 1320 in the 24-7-2023. The Social Science Statistical Package (SPSS, IBM, Chicago, USA, version 27). Utilizing the Shapiro-Wilk-Kolmogorov-Smirnov tests, the normal distribution of the data was ascertained. For categorical data, the data were expressed as numbers (%), and for numerical data, as a mean (standard deviation). For the categorical and numerical variables, the chi-square test and the independent sample t-test were utilized, respectively. p values were used to indicate significant differences.

Results

This study involved 250 patients in total, 147 (58.80%) were females and 103 (41.20%) were males. Additionally, 190 (76.00%) of the patients were from urban areas, and 60 (24.00%) were from rural ones. The mean age of participants and duration of Diabetes Mellitus were 59 years and 9.51 years, respectively, as shown in Table (1) and Figure (1).

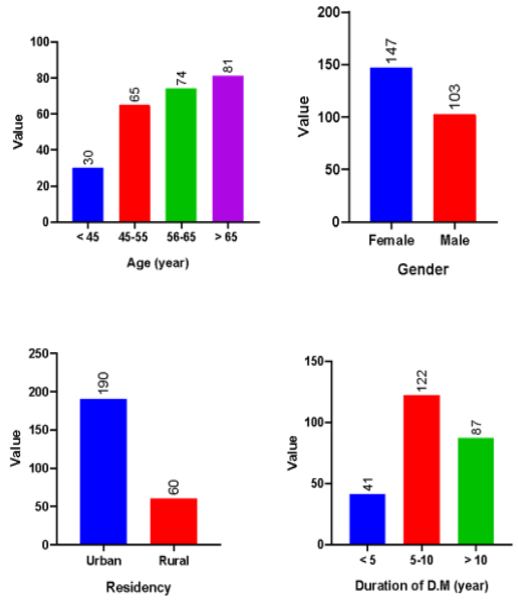

Figure (1): Sociodemographic and anthropometric characteristics of 250 patients with Diabetes Mellitus

Table (1): Sociodemographic and anthropometric characteristics of 250 patients with diabetes mellitus.

Variable		Frequency	Percentage
Age Mean±SD = 59 ± 11.21 years	< 45 years	30	12.00 %
	45-55 years	65	26.00 %
	56-65 years	74	29.60 %
	> 65 years	81	32.40 %
Gender	Female	147	58.80 %
	Male	103	41.20 %
Residency	Urban	190	76.00 %
	Rural	60	24.00 %
Duration of D.M Mean±SD = 9.51 ± 5.40 years	< 5 years	41	16.40 %
	5-10 years	122	48.80 %
	>10 years	87	34.80 %

%= percentage; SD= Standard deviation, D.M= Diabetes Mellitus.

Of the patients, 104 (41.60%) have had only diabetes mellitus, while 146 (58.40%) have had diabetes mellitus and another chronic illness. The majority of patients (64.00%) haven't had retinopathy, but 90 (36.00%) of them had retinopathy. Among the participants, 13 (5.20%) were using insulin therapy, 223 (89.20%) were using oral antidiabetic drugs, and 14 (5.60%) had used both insulin and oral medications. The study found that 127 (50.80%) they had not been on those medications that improve or slow down proteinuria, and 123 (49.20%) were on antiproteinuric medications, Table (2).

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Table (2): Clinical and biochemical characteristics of the patients.

Variable		Frequency	Percentage
Chronic Illness	Only diabetes	104	41.60 %
	Diabetes with other chronic disease	146	58.40 %
Retinopathy	No	160	64.00 %
	Yes	90	36. 00 %
Antidiabetic drugs	Insulin	13	5.20 %
	Oral antidiabetic	223	89.20 %
	Both	14	5.60 %
Using drugs cause decrease proteinuria	No	127	50.80 %
	Yes	123	49.20 %

This research shows that 81 out of 250 diabetic patients (32.40%) had developed diabetic nephropathy, among them, 71 (28.40%) have had microalbuminuria and 10 (4.00%) have had macroalbuminuria, as illustrated in Table (3) and Figure (2).

Table (3): prevalence of diabetic nephropathy

Diabetic patients (n=250)		Frequency	Percentage
No Nephropathy 169 (67.60%)	Normoalbuminuria	169	67.60 %
Diabetic Nephropathy 81 (32.40%)	Microalbuminuria	71	28.40 %
	Macroalbuminuria	10	4.00 %

N= number; %= percentage

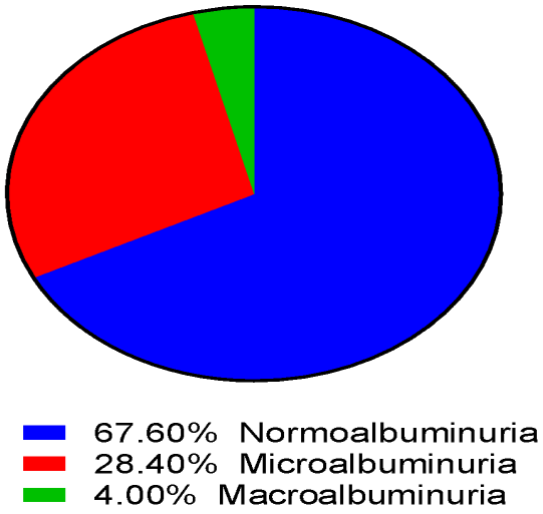

Figure (2): prevalence of diabetic nephropathy

The highest prevalence of nephropathy was found between those patients who were over 65 years old (43.9%), and the lowest frequency was seen among those participants aged less than 45 years old (4.9%). Gender had no significant effect on the prevalence of diabetic nephropathy, although the results showed that female patients had a higher percentage of diabetic nephropathy (61.7%) compared to male patients (38.3%). Sixty patients (74.1%) of those who developed diabetic nephropathy had been coming from urban areas, and 21 (25.9%) were from rural areas. Those participants who had diabetes mellitus for less than 5 years showed the lowest prevalence (2.5%), and the highest prevalence (54.3%) were reported among those patients who had diabetes mellitus for more than 10 years. The presence of other chronic illnesses with diabetes mellitus had showed significant effects on the development of diabetic nephropathy, in which, 63 (77.8%) of those patients who had other chronic illnesses were found to have diabetic nephropathy, compared to 18 (22.2%) of participants who had only diabetes mellitus. There was a significant relationship between diabetic retinopathy and nephropathy because 56 (69.1%) of those

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who had been diagnosing with diabetic nephropathy also had diagnosed with retinopathy. Regarding the antidiabetic medications of those patients who developed diabetic nephropathy, 10 (12.3%) were using insulin alone, 64 (79.00%) were using oral hypoglycemic agents alone, and 7 (8.6%) were putting on both insulin and oral agents. Among participants who developed diabetic nephropathy, 54 (66.7%) had been putting on antiproteinuric medications, while 69 (40.83%) of those patients who had no nephropathy were using antiproteinuric medications, as shown in Table (4).

Table (4): Prevalence of diabetic nephropathy among diabetics according to sociodemographic and clinical characteristics.

Variable		No nephropathy n(%)= 169 (67.60)	Diabetic Nephropathy n(%)= 81 (32.40)	p value
Age	Mean ± SD	57.72 ± 11.2	61.88 ± 10.84	0.005 *
	< 45 years	26 (15.38)	4 (4.9)	
	45-55 years	42 (24.85)	23 (28.0)	
	56-65 years	56 (33.14)	18 (22.2)	
	> 65 years	45 (26.63)	36 (43.9)	
Gender	Female	97 (57.4)	50 (61.7)	0.625 ns
	Male	72 (42.6)	31 (38.3)	
Residency	Urban	130 (76.92)	60 (74.1)	0.622 ns
	Rural	39 (23.080	21 (25.9)	
Duration of diabetes	< 5 years	39 (23.080	2 (2.5)	<0.001 **
	5-10 years	87 (51.48)	35 (43.2)	
	>10 years	43 (25.44)	44 (54.3)	
Chronic Illness	Only diabetes	86 (50.89)	18 (22.2)	<0.001 **
	Diabetes with other chronic disease	83 (49.11)	63 (77.8)	
Retinopathy	No	135 (79.88)	25 (30.9)	<0.001 **
	Yes	34 (20.12)	56 (69.1)	
Antidiabetic drugs	Insulin	3 (1.78)	10 (12.3)	0.001 *
	Oral antidiabetic	159 (94.08)	64 (79.0)	
	Both	7 (4.14)	7 (8.6)	
Using drugs that decrease proteinuria	No	100 (59.17)	27 (33.3)	0.001 *
	Yes	69 (40.83)	54 (66.7)	

N= number; %= percentage; ns= no significant difference; *= significant difference; **= highly significant difference.

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Among those patients who had diabetic nephropathy, the HbA1c level of 23 participants (28.4%) was equal to or below 7%, while 58 (71.6%) participants had reported an HbA1c level of more than 7%. Out of 31 patients whose urea level was high, 21 had diabetic nephropathy, and 17 out of 24 patients whose creatinine was high, had diabetic nephropathy. As found in Table (5).

Table (5): Relationship between prevalence of Diabetic nephropathy and Level of glycemic control and renal functions of the patients.

Variable		No nephropathy n(%)= 169 (67.60)	Diabetic Nephropathy n(%)= 81 (32.40)	p value
HbA1C level	=< 7%	65 (38.46)	23 (28.4)	0.119 ns
	> 7%	104 (61.54)	58 (71.6)	
Blood Urea	High level	10 (5.92)	21 (25.9)	<0.001 **
	Normal level	159 (94.08)	60 (74.1)	
Serum creatinine	High level	7 (4.14)	17 (21.0)	<0.001 **
	Normal level	162 (95.86)	64 (79.0)	

N= number; %= percentage; HbA1C= glycated hemoglobin; GFR=Glomerular filtration rate; ns= no significant difference; *= significant difference; **= highly significant difference.

Among the participants with diabetic nephropathy, 41 (50.6%) had stage 1 chronic kidney disease (CKD), 27 (33.3%) had stage 2 CKD, 10 (12.3%) had stage 3a CKD, 1 (1.2%) had stage 3b CKD, and 2 (2.5%) had stage 4 CKD. As clarified in Table (6).

Table (6): CKD stages of patients with diabetic nephropathy using Cockcroft-Gault equation.

Different CKD stages		Frequency	Percentage
CKD stages	Stage 1	41	50.6 %
	Stage 2	27	33. 3%
	Stage 3 a	10	12.3 %
	Stag 3 b	1	1.2 %
	Stage 4	2	2.5 %
	Stage 5	0	0%

Stage 1 = eGFR ≥90, stage 2 = eGFR 89-60, stage 3a = eGFR 59-45, stage 3b = eGFR 44-30, stage 4 = eGFR 29-15, stage 5 = eGFR ≤ 15.

Discussion

According to our research, 32.4% of the study population had developed Diabetic Nephropathy; of those, 28.4% had microalbuminuria and 4% had macroalbuminuria. This result corresponds to the findings of studies conducted by both Islam MR et al, and Aberra T et al, which disclosed Diabetic Nephropathy prevalence rates of 30.5% and 32%, accordingly,[7,8] and to another study carried out by Shahwan MJ et al, which reported Diabetic Nephropathy prevalence rates of 34.6%,[9] but surpassing the study performed by Ali AA et al, which reported 16.1%, and lower than the prevalence rate of a study conducted by Alrawahi AH et al, which reported 42.5%.[10,11] Discrepancy could be explained by variations in the analyzed sample's age distribution, race, the definition of albuminuria, and the evaluation techniques. The high rate of Diabetic Nephropathy in the study may be due to the increased incidence of Diabetes Mellitus, the availability of methods to detect microalbuminuria earlier, and the non-compliance of patients with antidiabetic medications. There is a

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significant relationship between the prevalence of Diabetic Nephropathy and the age of patients (p value 0.005), in which the highest prevalence noted among those patients whose age were over 65 years of age. This finding is parallel to the result of the study done by Aberra T et al, but against the result of the studies done by Ali AA et al, Alrawahi AH et al, and Al-Gefri et al, which failed to show any significant effect of age on the prevalence of Diabetic Nephropathy.[8,10,11,12] The gender of patients and their residency hadn't shown significant effects on the development of Diabetic Nephropathy (p values of 0.625 and 0.622, respectively). This finding is the same as the results of the studies that were performed by Ali AA et al and Al-Gefri et al.[10,12] However, a study performed by Alrawahi AH et al showed male gender as a risk factor for Diabetic Nephropathy,[11] and research conducted by Vimalkumar VK et al concluded that female gender was being associated with a higher prevalence of Diabetic Nephropathy.[13] Duration of Diabetes Mellitus is a highly significant (p value <0.001) risk factor for the development of Diabetic Nephropathy, in which 44 out of 87 participants who had Diabetes Mellitus for >10 years had developed Diabetic Nephropathy. Studies done by Islam MR et al, Al-Gefri et al, and Vimalkumar VK et al concluded the same result too.[7,12,13] The existence of other chronic illnesses with diabetes mellitus has a significant relationship to the occurrence of Diabetic Nephropathy (p value <0.001), because 77.8% of those who had developed Diabetic Nephropathy have had other chronic illnesses with Diabetes Mellitus. Our research had reported a high prevalence of diabetic retinopathy among those patients who had Diabetic Nephropathy, in which 69.1% of them had diabetic retinopathy, If we look at the studies that were conducted by Aberra T et al and Vimalkumar VK et al, we can find the same result.[8,13] But a study performed by Alrawahi AH et al did not detect any association between diabetic retinopathy and nephropathy.[11] Antiproteinuric drugs, such as ACEi, ARBs, and SGLT2 inhibitors, were used by 66.7% of individuals who had Diabetic Nephropathy, indicating that using these drugs doesn't protect against Diabetic Nephropathy, the study concluded. This result is consistent with study conducted by Ali AA et al, in which antiproteinuric medications were not shown to be significantly correlated with the prevalence of Diabetic Nephropathy.[10] This could be because those patients had been starting on those medications following their diagnosis of Diabetic Nephropathy. Nonetheless, the findings of a study conducted by Aberra T et al indicated how significant such agents were in the frequency of Diabetic Nephropathy.[8] The Glycated Hemoglobin level had no significant relationship with the prevalence of Diabetic Nephropathy (p value 0.119); it may reflect the changes in HbA1c level throughout the course disease of Diabetes Mellitus. This result is similar to the research performed by Al-Gefri et al, but it's against the results of the studies conducted by Islam MR et al, Alrawahi AH et al, and Lalramenga PC et al, that concluded the significant effect of poor glycemic control on the development of diabetic nephropathy.[7,11,12,14] The study found that the majority of those patients who developed Diabetic Nephropathy had normal blood urea and serum creatinine. Table (5). So that physicians shouldn't depend on the Renal Function Test alone in determining the renal status of diabetic patients. Nonetheless, Islam MR et al found that elevated serum creatinine levels are linked to diabetic nephropathy.[7] Our study is subject to certain limitations, including a small sample size resulting from time constraints and a missing data area pertaining to characteristics (such as obesity, smoking, and so on) that could have impacted the findings if they had been available. We relied on patient data for

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certain variables, which may have been skewed by recollection bias. We also had trouble determining the precise age at which diabetes mellitus first manifested itself.

Conclusion

In this study, one-third of the type two diabetic patients had diabetic nephropathy. Age, other chronic conditions, and the length of DM all had a major impact on DN. Nevertheless, the incidence of DN was not significantly impacted by gender, place of residence, or HbA1c level.

Conflict of interest

The authors report no conflict of interest.

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