Vol. 5 No. 1 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

ROLE OF RENAL ULTRASONOGRAPHY IN DIABETIC NEPHROPATHY PATIENTS AND ITS CORRELATION WITH RENAL FUNCTION TESTS

Muhammad Siaf Rasool
Gomal University DI Khan
siaflakhani@gmail.com
Tasleem
Gomal University DI Khan
threestar7624@gmail.com
Muhammad Fareed Elahi
Clinical Technologist Radiology ATH Abbottabad
fareed.elahi73@gmail.com
Sharifullah
Senior lecturer MIT FAHS Gomal university DI khan
sharifullahwazir250@gmail.com
Kainat Zaman
Gomal University DI Khan
zamankainat047@gmail.com
Pakiza muskan
Gomal University DI Khan
pakizamuskan63@gmail.com
Asad ullah
Gomal University DI Khan
asadwazir064@gmail.com
Fazeela Mushtaq
Gomal University DI Khan
fazeelamushtaq92@gmail.com
Dr Muhammad Arshad*
Assistant professor of Radiology University of Haripur
phool2110@gmail.com

Author Details

Keywords: Ultrasonography, Renal Function test, Nephropathy

Received on 25 Feb 2026
Accepted on 19 March 2026
Published on 27March 2026

Corresponding E-mails & Authors*:
Dr Muhammad Arshad*
phool2110@gmail.com

Abstract

Background:. Diabetic nephropathy is a serious complication of type 1 diabetes and type 2 diabetes. It's also called diabetic kidney disease. In the United States, about 1 in 3 people living with diabetes have diabetic nephropathy. This study aims to assess and compare the sensitivity of ultrasonography as a diagnosing modality to evaluate diabetic nephropathy with altered renal function test.

Material and Method: The current study was cross sectional and conducted between period of November 2026 March 2026.The current study was conducted at. Convenient sampling technique was used for sample collection. Each underwent renal grayscales USG alongside standard RFTs, aiming to investigate relationship between ultrasonography and RFTS outcome.

Results: A total of 105 sample were collected from the patients with Diabetic nephropathy. Among them, 46 male (43.8%) of the total, while 59 are female, representing 56.2%. The majority of patients (30.4%) fall within the 41-50 age range. The 41-50 age group has the largest representation, with 32 patients (11.4% male and 19% female). Next is the 51-60 age group, comprising 28 patients. Among the 105 patients, 41 (39%) have Type 1 Diabetes Mellitus (1DM), while 64 (61%) have Type 2 Diabetes Mellitus (2DM). Among the 27 male patients, the mean serum creatinine level is 1.43, and the mean eGFR is 54.42. For the 37 female patients, the mean serum creatinine level is slightly higher at 1.6, with the mean eGFR being 54.47. in Type 2 Diabetes Mellitus males have marginally higher serum creatinine levels (1.38) than female. cortical thickening showing the highest serum creatinine (2.9).

Conclusion: Female patients is slightly higher than that of male patients total of 105 patients. Type 2 Diabetes is more prevalent in the patient population compared to Type1. Type1 Diabetes Mellitus females have higher serum creatinine levels than males. Type 2 Diabetes Mellitus males exhibit slightly higher serum creatinine levels compared to females. Cortical thickening showing the highest serum creatinine across various kidney diseases.

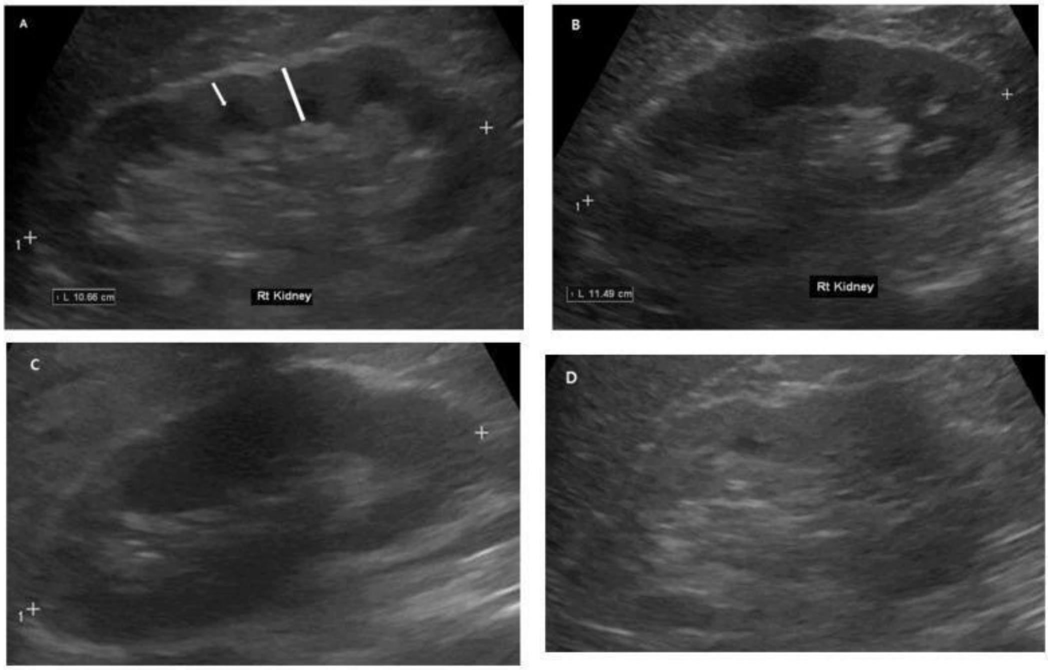
INTRODUCTION

INTRODUCTION

Diabetic kidney disease (DKD) is another name for diabetic nephropathy (DN).A prevalent consequence of diabetes is diabetic nephropathy. It is the primary cause of end-stage renal disease, according to research.According to statistics, diabetic nephropathy affects at least 30% of diabetic patients, placing a significant burden on public health (Samsu, 2021)[1].While the proportion of incident ESKD patients with diabetes rose from 22.1% to 31.3%, the prevalence of diabetes-related ESKD patients worldwide rose from 19.0% in 2000 to 29.7% in 2015.Diabetes affects 564 million people worldwide at the moment, and by 2035, that number is expected to rise to 600 million[2].

A clinical sign of kidney damage brought on by persistent, long-term hyperglycemia is diabetic nephropathy.Extrarenal microvascular consequences of diabetes, such as peripheral neuropathy and retinopathy, as well as macrovascular complications, such as peripheral vascular disease, coronary artery disease, and stroke, combine to cause kidney disease [3].Controlling the disease's progression and detecting it early are crucial. Imaging techniques such as Doppler tracing and ultrasound have been crucial in identifying diabetic nephropathy, and as a result, have produced vital diagnostic and prognostic data [4].

A key component of renal diagnosis, grayscale sonography provides fundamental anatomical information including renal length, cortical thickness, and collecting system dilatation. Due to its accessibility, cost, convenience of use, and lack of negative side effects, color Doppler and ultrasonography (USG) are frequently used in the first evaluation of renal disorders. Although the USG is frequently used to diagnose urological, vascular, and tubulointerstitial illnesses, its utility in treating medical renal problems is still rather restricted. In order to evaluate medical renal disorders with altered renal function tests (RFTs), this study compares and evaluates the sensitivity of transabdominal and Doppler sonograph as a diagnostic tool [5].



(Representative picture of ultrasound findings)
(A) a 63-year-old male with normal renal ultrasound; (B) a 54-year-old female with diabetes; (C) a 54-year-old male with eGFR > 60 mL/min/1.73 m2; (D) a 65-year-old male with eGFR 45 mL/min/1.73 m2 (arrow: measurement of cortical thickness; bar: measurement of parenchymal thickness).

Differences in ultrasonography results between patients with and without diabetes mellitus have been found in a number of prior research. In contrast to patients without DM, they found that patients with early-stage DM had larger and longer kidneys as well as increased renal cortical echogenicity. Furthermore, according to recent research, renal size can be utilized to forecast the onset and course of microalbuminuria in individuals with type 1 diabetes [6].

According to the U.S. Renal Data System (USRDS), diabetes mellitus is the primary cause of chronic kidney disease, with 40% of patients with CKD also having diabetes (USRDS 2016). Based on the presence of albuminuria, a decrease in glomerular filtration rate (GFR), and the presence of advanced stages of fibrosis from a morphological perspective, diabetic kidney disease is a clinical diagnostic [11].

The kidneys' length, parenchymal thickness, and parenchymal echogenicity are the fundamental parameters assessed in renal US. It is well known that as CKD progresses, parenchymal echogenicity rises and kidney length and parenchymal thickness decrease.Additionally, there is a correlation between the severity of CKD and estimated glomerular filtration rate (e-GFR). There is, however, little information available regarding the relationship between e-GFR and each of these three renal US measures in CKD patients. The purpose of this study was to examine the relationship between e-GFR and the ultrasonographic CKD score that was determined using these ultrasonographic data [12].

MATERIALS AND METHODS

Study design

The current study was cross-sectional.

Study settings

The study was conducted in DHQ Hospital and private clinics of ultrasound and laboratories in Dera Ismail Khan Pakistan. Ethical approval for this research work was taken from Institutional research Board (IRB) of DHQ Hospital.

Study duration

The study spanned over a period of 6 months, allowing sufficient time for data collection, analysis, and interpretation of results.

Sample size

The sample size for the study was determined to be 109, which was calculated with the help of OpenEpi calculator, version 3 keeping Confidence level of 95% and Error margin of 5% a shown in Figure 3.1.

Sample Size for % Frequency in a Population (Random Sample)		
Population size	150	If large, leave as one million
Anticipated % frequency(p)	50	Between 0 & 99.99. If unknown, use 50%
Confidence limits as +/- percent of 100	5	Absolute precision %
Design effect (for complex sample surveys--DEFF)	1.0	1.0 for random sample

Figure 3.1: Sample size Calculation

Sample Size for Frequency in a Population

Population size(for finite population correction factor or fpc)(*N*):	150
Hypothesized % frequency of outcome factor in the population (*p*):	50%+/-5
Confidence limits as % of 100(absolute +/- %)(*d*):	5%
Design effect (for cluster surveys-*DEFF*):	1

Sample Size(*n*) for Various Confidence Levels

ConfidenceLevel(%)	Sample Size
95%	109
80%	79
90%	97
97%	114
99%	123
99.9%	132
99.99%	137

Inclusion Criteria

Patients with a history of diabetes mellitus (type 1 or type 2).

Patients undergoing renal function test including serum creatinine and estimated glomerular filtration rate.

Exclusion Criteria

Patients with history of renal disease not related to diabetic nephropathy

e.g (polycystic kidney disease,glomerulonephritis)

Studies lacking clear documentation of renal function test.

Data collection procedure

After approval of proposal from Institutional Research Board (IRB) of Faculty of allied health sciences Gomal university Dera ismail khan, . Data was collected through ultrasound machine to acess renal parameters. Serum creatinine and GFR was collected for analysis .The analysis focus on correlating ultrasonographic findings with renal function test parameters.

RESULTS

Table 4.1 illustrates the gender-wise distribution of 105 patients. Among them, 46 are male, accounting for 43.8% of the total, while 59 are female, representing 56.2%. This indicates that the proportion of female patients is slightly higher than that of male patients in the group.

Table 4.1: Gender wise distribution of patients

Gender	Number	Percentage
Male	46	43.8
Female	59	56.2

Total	105	100

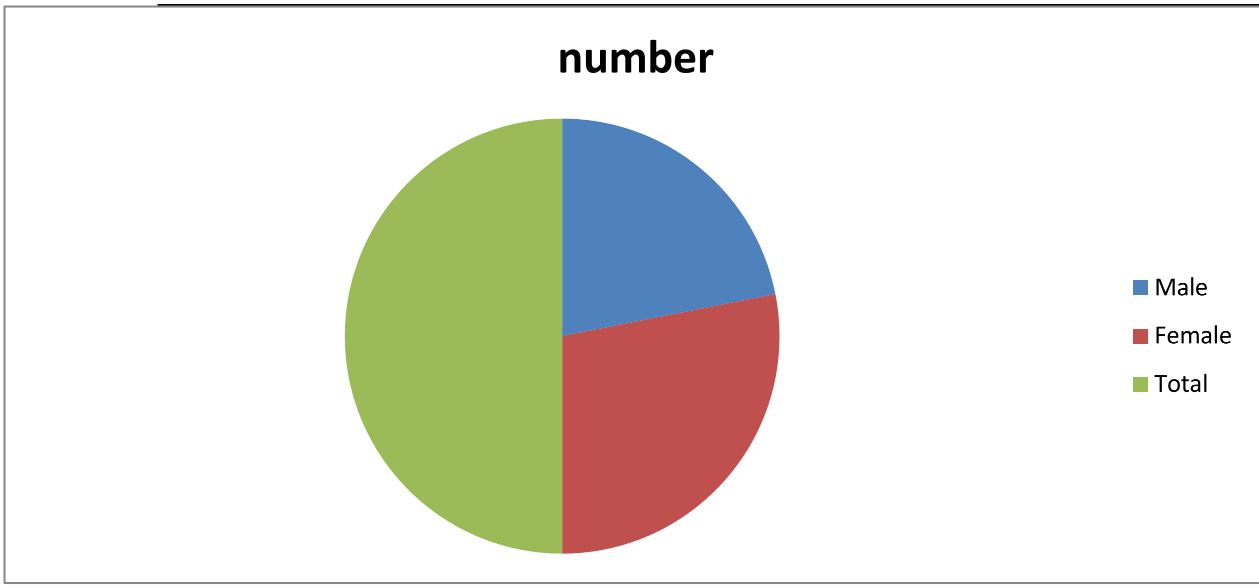


Table 4.2 presents the age-wise distribution of patients across six age groups. The majority of patients (30.4%) fall within the 41-50 age range, followed by 26.7% in the 51-60 range and 23.8% in the 61-70 range. Smaller proportions are observed in the 30-40 and 71-80 age groups, each comprising 6.7% of the total, while only 5.7% of patients are over 80 years old. This distribution shows a concentration of patients in the middle-aged to early senior age ranges.

Table 4.2: Age wise distribution of patients

Age group	Number	Percentage
30-40	7	6.7
41-50	32	30.4
51-60	28	26.7
61-70	25	23.8
71-80	7	6.7
>80	6	5.7

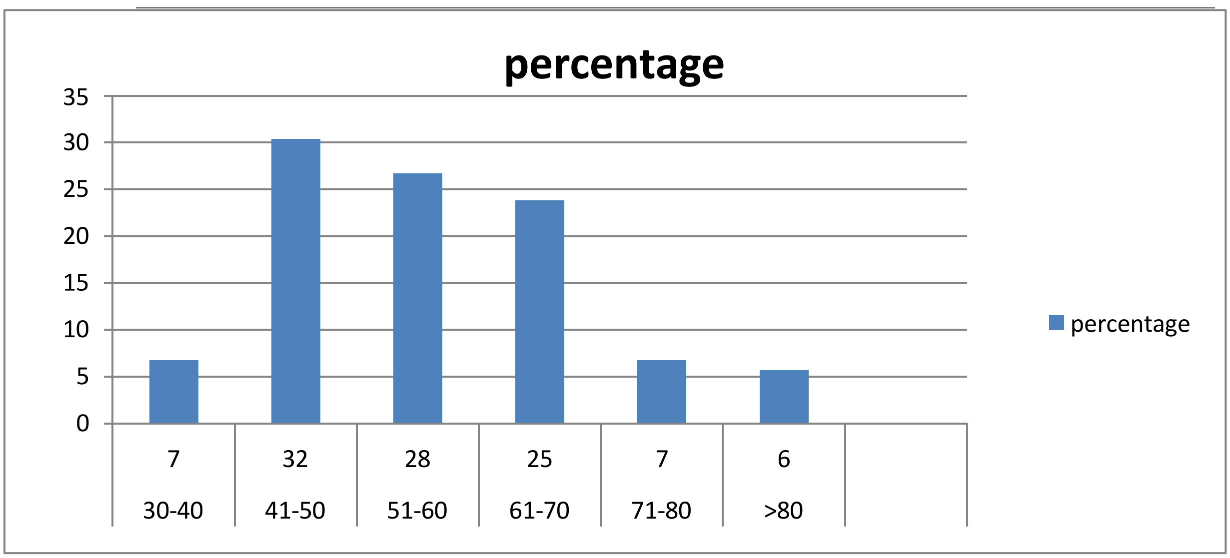


Table 4.3 categorizes patients by age and gender, arranged from the highest to lowest total number of patients. The 41-50 age group has the largest representation, with 32 patients (11.4% male and 19% female). Next is the 51-60 age group, comprising 28 patients (12.4% male and 14.3% female), followed by the 61-70 age group with 25 patients (11.4% male and 12.4% female). The 30-40 and 71-80 age groups each have 7 patients; the 30-40 group consists of 1.9% male and 4.8% female, while the 71-80 group includes 2.8% male and 3.8% female. Lastly, the >80 age group has the fewest patients, with 6 in total (3.8% male and 1.9% female). This distribution highlights the predominance of patients in the middle-aged and early senior age ranges.

Table 4.3: Categorization of patients according to male and female percentage.

	Male	female	Total
Age Category	n(%)	n(%)	n(%)
30-40	2(1.9)	5(4.8)	7(100)
41-50	12(11.4)	20(19)	32(100)
51-60	13(12.4)	15(14.3)	28(100)
61-70	12(11.4)	13(12.4)	25(100)
71-80	3(2.8)	4(3.8)	7(100)
>80	4(3.8)	2(1.9)	6(100)

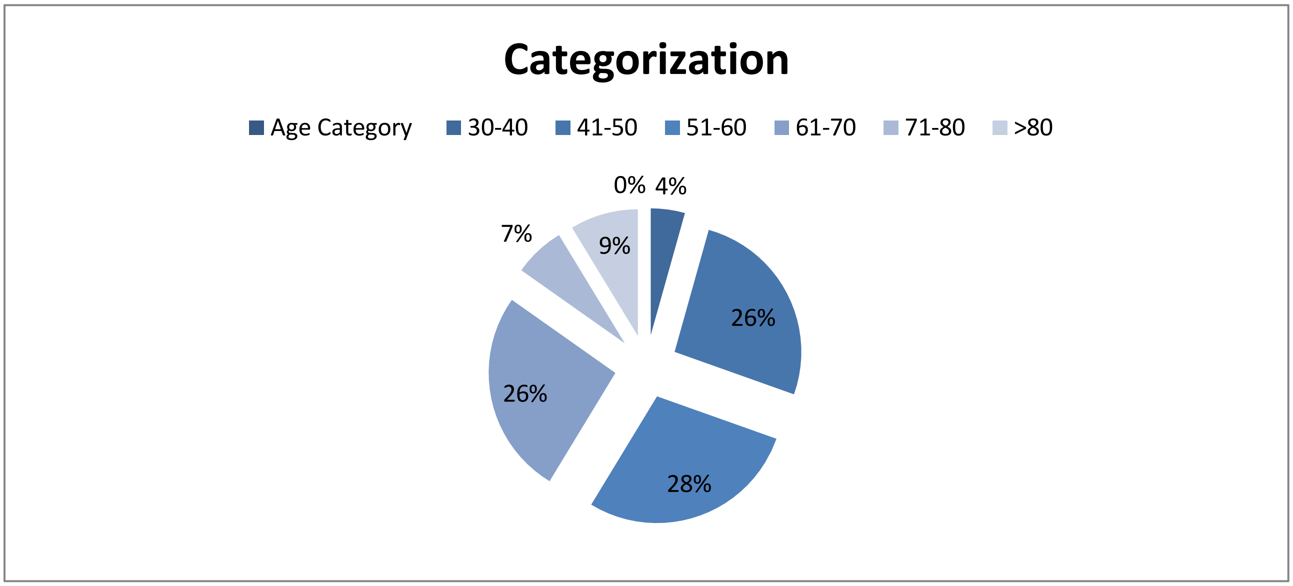


Table 4.4 presents the distribution of patients based on the type of diabetes mellitus. Among the 105 patients, 41 (39%) have Type 1 Diabetes Mellitus (1DM), while 64 (61%) have Type 2 Diabetes Mellitus (2DM). This indicates that Type 2 Diabetes is more prevalent in the patient population compared to Type 1.

Table 4.4: distribution of patients according to type1 and type2 diabetes millitus

Diseases	frequency	percentage
1DM	41	39
2DM	64	61
total	105	100

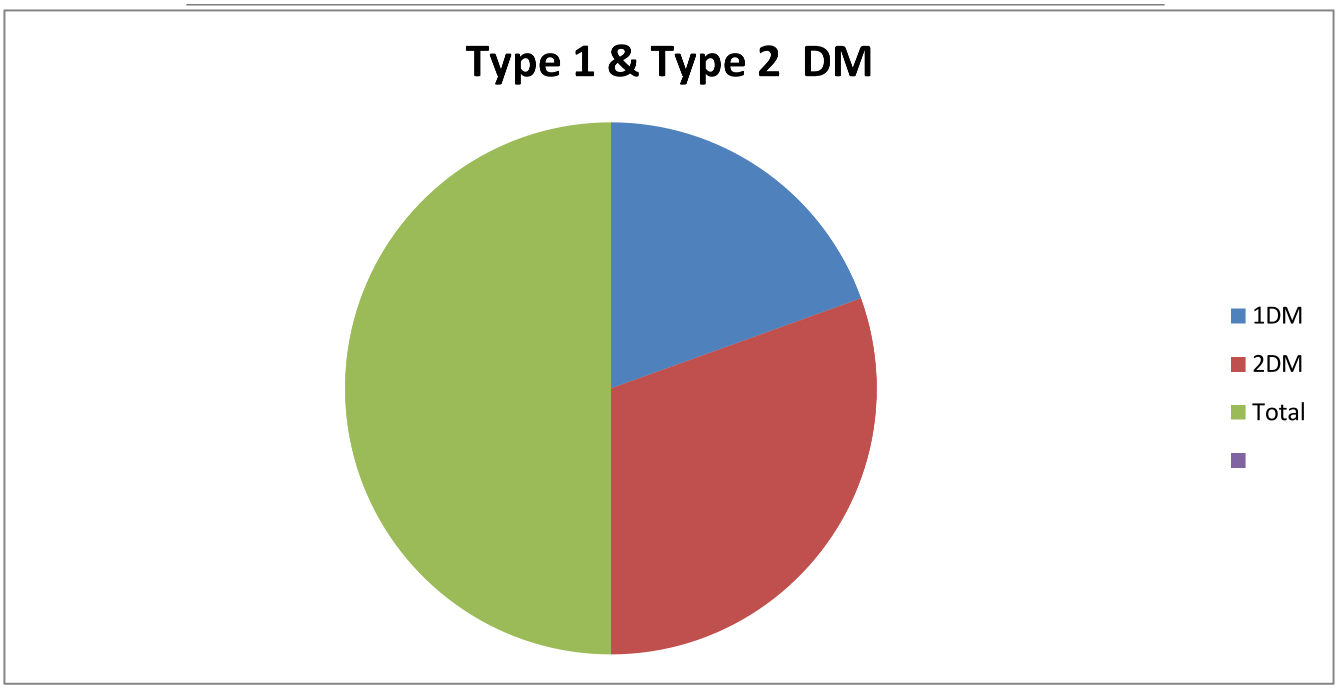


Table 4.5 categorizes male and female patients based on Type 1 and Type 2 Diabetes Mellitus. Among the 41 patients with Type 1 Diabetes (1DM), 19 (18%) are male, and 22 (21%) are female. For the 64 patients with Type 2 Diabetes (2DM), 27 (25.7%) are male, and 37 (35.3%) are female. Overall, the total population comprises 46 males (39%) and 59 females (61%), indicating that females are more prevalent in both diabetes categories.

Discussion

The patient population shows a higher prevalence of females (56.2%) compared to males (43.8%). This finding is consistent with studies that report a higher prevalence of diabetes among women in certain populations due to factors such as hormonal differences, lifestyle, and metabolic predispositions. For example, a study by Wild et al. (2004) highlighted gender-specific variations in diabetes prevalence, attributing these disparities to differences in obesity rates and healthcare access[36].

The concentration of patients in the 41–70 age range (80.9%) suggests that diabetes is most prevalent in middle-aged and early senior individuals. This aligns with findings by Shaw et al. (2010), which showed a sharp increase in diabetes incidence with age, particularly in the 40–70 age bracket. The reduced representation in older age groups may reflect higher mortality rates or fewer older individuals seeking care. The predominance in these age ranges underscores the importance of early intervention strategies targeting this demographic[37].

The higher prevalence of Type 2 Diabetes Mellitus (61%) compared to Type 1 Diabetes Mellitus (39%) aligns with global epidemiological patterns. Studies, such as those by Zimmet et al. (2001), have established that Type 2 Diabetes is the predominant form of diabetes, particularly in adults over the age of 40. This reflects lifestyle factors such as obesity, sedentary behavior, and dietary habits that contribute to the development of Type 2 Diabetes[38].

The data indicate that females are more prevalent than males in both Type 1 and Type 2 Diabetes categories. This observation supports findings in certain cohorts where females exhibited a higher risk of developing diabetes complications, possibly due to delayed diagnosis or gender- specific metabolic differences.

Kautzky-Willer et al. (2016) discuss the impact of sex-specific hormones and their role in modulating insulin sensitivity and metabolic syndrome, which may explain these differences[39].

Serum creatinine and eGFR levels among patients with Type 2 Diabetes reveal minimal differences between genders, with females showing slightly higher serum creatinine levels (1.6 vs. 1.43). This is in agreement with research, such as Levey et al. (1999), which indicates that eGFR is a more stable marker for assessing renal function despite creatinine variability due to muscle mass differences[40].

The correlation of renal function with kidney conditions, such as cortical thickening and increased echogenicity, underscores the role of structural abnormalities in deteriorating kidney function. Patients with cortical thickening exhibited the highest serum creatinine levels (2.9) and moderately preserved eGFR (52), indicating advanced renal impairment.

CONCLUSION

Our finding indicates that the proportion of female patients is slightly higher than that of male patients total of 105 patients. The majority of patients both male and female (30.4%) fall within the 41-50 age range

Type 2 Diabetes is more prevalent in the patient population compared to Type 1.

The total population comprises 46 males (39%) and 59 females (61%), indicating that females are more prevalent in both diabetes categories.

Type 1 Diabetes Mellitus Females tend to have marginally higher serum creatinine levels, while eGFR values remain comparable between male and female.

Male have higher serum creatinine levels, females exhibit slightly better renal function as indicated by eGFR values.

Males with Type 2 Diabetes Mellitus exhibit slightly higher serum creatinine levels compared to females, females show marginally better renal function as reflected by higher eGFR values

Cortical thickening showing the highest serum creatinine across various kidney diseases.

REFERENCES

Hu, Q., Jiang, L., Yan, Q., Zeng, J., Ma, X., & Zhao, Y. (2023). A natural products solution to diabetic nephropathy therapy. Pharmacology & Therapeutics, 241, 108314.

Naaman, S. C., & Bakris, G. L. (2023). Diabetic Nephropathy: Update on Pillars of therapy Slowing progression. Diabetes Care, 46(9), 1574–1586.

Mohammed, M. M., Alnajim, E. K., Hussein, M. a. A., & Hadi, N. R. (2023). RISK FACTORS FOR DIABETIC NEPHROPATHY IN DIABETES MELLITUS TYPE 1. *Wiadomości Lekarskie,*

Sharma, K., Thakur, M. K., Mahela, S., Konwar, R., Varma, D., Ullah, I. K., & Baishya, N. K. (2023). Role of renal doppler ultrasonography in evaluating renal haemodynamics in diabetic patients and its correlation with laboratory parameters (serum HbA1C and serum creatinine).

Ham, Y. R., Lee, E. J., Kim, H. R., Jeon, J. W., Na, K. R., Lee, K. W., & Choi, D. E. (2023). Ultrasound Renal Score to Predict the Renal Disease Prognosis in Patients with Diabetic Kidney Disease: An Investigative Study. Diagnostics, 13(3), 515

Polaka, Y., Christina, E. P., Ramakrishnan, K. K., Mohanakrishnan, A., & Natarajan, P. (2024). A study assessing the role of renal grayscale ultrasonography and flowmetry in correlation with renal function tests across various renal diseases. Curēus.

Lin J, Liu G, Lin Y, Wei C, Liu S, Xu Y. Ultrasonography Combined with Blood Biochemistry on the Early Diagnosis of Diabetic Kidney Disease. Dis Markers. 2022 Oct 5;2022:4231535. doi: 10.1155/2022/4231535. PMID: 36246564; PMCID: PMC9556206.

Shi LQ, Sun JW, Miao HH, Zhou XL. Comparison of Supersonic Shear Wave Imaging-Derived Renal Parenchyma Stiffness Between Diabetes Mellitus Patients With and Without Diabetic Kidney Disease. Ultrasound Med Biol. 2020 Jul;46(7):1630-1640. doi: 10.1016/j.ultrasmedbio.2020.03.026. Epub 2020 May 11. PMID: 32404297.

Ghadirpour A, Tarzamni MK, Naghavi-Behzad M, Abedi-Azar S, Koushavar H, Nezami N. Renal vascular Doppler ultrasonographic indices and carotid artery intima-media thickness in diabetic nephropathy. Med Ultrason. 2014 Jun;16(2):95-9. doi: 10.11152/mu.2013.2066.162.ag1mkt2. PMID: 24791839.

Jeong SH, Jung DC, Kim SH, Kim SH. Renal venous doppler ultrasonography in normal subjects and patients with diabetic nephropathy: value of venous impedance index measurements. J Clin Ultrasound. 2011 Nov-Dec;39(9):512-8. doi: 10.1002/jcu.20835. Epub 2011 May 4. PMID: 21544829.

Bob F, Grosu I, Sporea I, Bota S, Popescu A, Sima A, Şirli R, Petrica L, Timar R, Schiller A. Ultrasound-Based Shear Wave Elastography in the Assessment of Patients with Diabetic Kidney Disease. Ultrasound Med Biol. 2017 Oct;43(10):2159- 2166. doi: 10.1016/j.ultrasmedbio.2017.04.019. Epub 2017 Jul 15. PMID: 28720285.

Yaprak M, Çakır Ö, Turan MN, Dayanan R, Akın S, Değirmen E, Yıldırım M, Turgut F. Role of ultrasonographic chronic kidney disease score in the assessment of chronic kidney disease. Int Urol Nephrol. 2017 Jan;49(1):123-131. doi: 10.1007/s11255-016-1443-4. Epub 2016 Oct 28. PMID: 27796695.

Li N, Wang YR, Tian XQ, Lin L, Liang SY, Li QY, Fei X, Tang J, Luo YK. Potential value of three-dimensional ultrasonography in diagnosis of diabetic nephropathy in Chinese diabetic population with kidney injury. BMC Nephrol. 2020 Jun 29;21(1):243. doi: 10.1186/s12882-020-01902-w. PMID: 32600283; PMCID: PMC7325142.

Zhang H, Huang L, Yang Y, Qiu L, He Q, Liu J, Qian L, Luo J. Evaluation of Early Diabetic Kidney Disease Using Ultrasound Localization Microscopy: A Feasibility Study. J Ultrasound Med. 2023 Oct;42(10):2277-2292. doi: 10.1002/jum.16249. Epub 2023 May 5. PMID: 37146242.

Abe M, Akaishi T, Miki T, Miki M, Funamizu Y, Araya K, Ishizawa K, Takayama S, Takase K, Abe T, Ishii T, Ito S. Influence of renal function and demographic data on intrarenal Doppler ultrasonography. PLoS One. 2019 Aug 27;14(8):e0221244. doi: 10.1371/journal.pone.0221244. PMID: 31454365; PMCID: PMC6711528.