JPSIM Journal of Pakistan Society of Internal Medicine

Original Article

Nephrolithiasis; Comparison of Diabetic and Non-Diabetic Patients in A Tertiary Care Hospital

Madeeha Nazar,[1] Shahana Ghazal,[1] Unaiza Sharif,[1] Sadia M. Azam Khan,[1] Muhammad Rizwan Mahmud,[2] Qurat-ul-Ain[1]

[1]Holy Family Hospital, Rawalpindi, Pakistan, [2]Benazir Bhutto Hospital, Rawalpindi, Pakistan

Abstract

Objective: To evaluate the clinical characteristics of patients with and without diabetes who had nephrolithiasis and investigate any meaningful correlations between the severity of the condition and diabetes.

Methodology: Over the course of three months, 210 patients with a diagnosis of nephrolithiasis were included in a comparative cross-sectional study at the Rawalpindi Institute of Urology and Transplantation. Structured interviews and clinical examinations, including imaging and lab results, were used to gather data. Groups of patients with and without diabetes were created. Chi-square tests were used to compare categorical variables, while independent samples t-tests were used to analyze quantitative variables.

Results: Participants were 44.86 ± 14.01 years old on average. Diabetics had greater HbA1c ($p < 0.001$), higher creatinine levels ($p < 0.001$), and considerably longer stone length ($p < 0.001$). Diabetes was significantly associated with right/left hydronephrosis, renal thinning, hematuria ($p = 0.009$), recurrent UTIs ($p < 0.001$), family history ($p < 0.001$), and reduced kidney size (all $p < 0.001$), according to chi-square analysis. Crystals of uric acid were more common than those of calcium oxalate.

Conclusion: More severe clinical and structural consequences in nephrolithiasis are significantly correlated with diabetes. These results emphasize how crucial it is to check diabetes patients for early indications of stone formation in order to avoid consequences.

Keywords: Nephrolithiasis, Diabetes Mellitus, Hydronephrosis, HbA1c

How to cite this:
Nazar M, Ghazal S, Sharif U, Khan SMA, Mahmud MR, Ain QU. Nephrolithiasis; Comparison of Diabetic and Non-Diabetic Patients in A Tertiary Care Hospital. J Pak Soc Intern Med. 2026;7(4): 305-311

Corresponding Author: Dr. Madeeha Nazar **Email:** madeehanazar@gmail.com

Received: 09-07-2026 **Revised:** 11-09-2026 **Accepted:** 04-11-2026 **DOI:** https://doi.org/10.70302/jpsim.v7i4.2661

2709-8729/© 2026 The Author(s). Published by JPSIM on behalf of Pakistan Society of Internal Medicine, Lahore, Pakistan. This is an open access article under the CC BY 4.0 license https://creativecommons.org/licenses/by/4.0/

Introduction

Urolithiasis is caused by formation of hard stones in the urinary tract and can be of variable shapes, sizes and composition, that are either located inside the kidney or get dislodged from the kidney and obstruct the urinary tract. It has a number of causative factors including polygenetic inheritance. Worldwide prevalence of urolithiasis is documented to be 2 to 20 % while in Asia, it is reported to be 1 to 5 % and in Pakistan it is reported to be 3%.[1] It can occur in population of any age, gender, ethnicity but is more common in men then in women, between the age of 20 to 49. In the absence of preventive measures, urolithiasis has a high chance of recurrence with advancing age.[2]

Decreased water intake, infections, increased intake of certain food rich in calcium, phosphate and oxalate or drugs interfering with absorption / secretion of these minerals as well as various metabolic diseases can lead to formation of renal stones. This is due to super saturation of urine with these minerals, whose concentration exceeds their solubility, that leads to formation of crystals such as Calcium phosphate or uric acid by the process of nucleation. Its size increases with deposition of more minerals in the crystals and eventually many crystals aggregate to form larger stones. This aggregation is determined greatly by the pH of urine, urinary stasis and factors that promote stone formation. These stones then adhere to the renal papilla and more proteins and organic material gather around the stones in the form of matrix. These stones either stay in the kidney or can migrate in the tract leading to pain or obstruction.

Patients with nephrolithiasis can experience severe, episodic colicky pain radiating from flank to groin, in

the presence of large stones in urinary tract.[3] Obstruction of the urinary passage can cause excruciating pain that might be accompanied with nausea and vomiting. Both acute and prolonged obstruction of the urinary tract can cause urinary tract infections, hydronephrosis, hematuria, urinary retention or can even lead to chronic renal failure.[4] Nephrolithiasis has a number of risk factors including positive family history, renal tubular acidosis, repeated urinary tract infections, decreased water intake, hyperparathyroidism, metabolic diseases like hypercalciuria, hyperoxaluria, hypocitraturia, hyperuricosuria, history of gout, increased intake of animal proteins and salt, decreased intake of chelating agents like fiber, citrate and alkali food. Diseases that cause inflammation of bowel and long-term use of drugs such as antacids, calcium supplements and diuretics are also linked to nephrolithiasis.[3]

Obesity and Diabetes mellitus have a strong association with the occurrence of renal stones. Many studies showed that Urolithiasis is more common in patients with Diabetes with predominantly calcium and uric acid stones.[5,6] Among patients with diabetes, gender wise nephrolithiasis occurs more in males. Insulin resistance in diabetes also causes increased secretion of ammonia in urine leading to urinary acidification and increased stone formation by causing excretion of calcium and uric acid.[7] Generally, the pH of urine in patients with diabetes is low which causes production of uric acid stones and also results in decreased urinary citrate levels, further leading to formation of calcium stones. Hyperglycemia also causes increased urinary calcium, phosphorus, uric acid and oxalate secretion.

Some studies done in Pakistan have also reported increased prevalence of renal stones in patients with diabetes as compared to patients without diabetes. In past few years, Pakistan has seen a tremendous rise in the cases of diabetes. Currently, Pakistan has the highest population of diabetic patients worldwide(8). Raising awareness about the association of renal stones with a common condition like diabetes is important, so that it is screened and diagnosed before it can cause agonizing pain or complications. Our study is conducted at a tertiary care hospital dedicated for patients with urological diseases in Rawalpindi.

Methodology

Over the course of three months, from January 15 to April 15, 2024, the Rawalpindi Institute of Urology and Transplantation (RIUT) conducted this comparative cross-sectional study. Patients between the ages of 12 and 80 who presented to RIUT's indoor, outpatient, and emergency departments and who had been diagnosed with nephrolithiasis based on CT KUB or ultrasonography were included in the study population. A non-probability consecutive sampling method was used to recruit 210 patients in total. The WHO sample size calculator was used to determine the sample size, which had a 95% confidence level, a 3% absolute precision, and a 5% expected population percentage.

Male and female patients with a confirmed diagnosis of nephrolithiasis between the ages of 12 and 80 met the inclusion criteria. Patients who had autoimmune diseases, were pregnant or nursing, had any cancer or were receiving chemotherapy, or had renal failure were not included. Structured interviews and observation-based methods were used to gather data, and a pre-made proforma was used to record the information.

The institutional review board granted ethical approval, and each subject gave their informed oral permission. In addition to clinical history, which included presenting complaints, history of urinary tract infection, hematuria, family history of nephrolithiasis, and duration since diagnosis (if known), data collection also included demographic information, such as age, gender, and place of residence. To determine the quantity, size, site (right, left, or bilateral), and anatomical location of stones (renal pelvis, calyces, proximal or distal ureter), imaging results from ultrasound or CT KUB were documented.

Other complications included decreased kidney size, cortical thinning, and hydronephrosis. Serum creatinine levels, recent urine routine examinations (R/E), and information on diabetes status, including history, duration, compliance, and HbA1c values, were recorded. Anemia thresholds were determined as Hb <12g/dl in females and <14g/dl in males, with HbA1c ≤7.5% being considered good glycemic control.

SPSS version 27.0 was utilized for data analysis. Group A consisted of individuals with diabetes, whereas Group B consisted of those without the disease. Using the independent samples t-test, quantitative factors like age, number, and size of stones were compared between groups and provided as mean ± standard deviation. Using the chi-square test, categorical variables such gender, the occurrence of complications, and stone laterality were examined. A p-value of less than 0.05 was deemed statistically significant.

Results

The study included 210 patients, ages 19 to 73, with a mean age of 44.86 ± 14.01 years. There were 47.6% men and 52.4% women in the gender distribution. A documented history of diabetes was present in 50% of the patients. The mean length of diabetes among diabetics was 4.72 ± 5.23 years, ranging from 0 to 16 years, whereas the average duration of stone disease was 14.88 ± 10.28 months (range: 1–37 months). Ninety percent of patients had a positive family history of kidney stones, indicating a substantial familial risk. In terms of urine crystal analysis, 46.7% had calcium oxalate crystals and 53.3% had uric acid crystals.

The mean hemoglobin and serum creatinine were 13.23 ± 1.15 g/dL and 1.25 ± 0.40 mg/dL, respectively, while the mean HbA1c was 7.17 ± 1.44%, with a range of 4.8 to 9.5%. The average pH of urine was 6.23 ± 0.44, and the mean counts of pee pus cells and RBCs per high-power field were 12.89 ± 5.22 and 8.97 ± 4.20, respectively. Thirty-nine percent had one kidney stone, thirty-five percent had two, and thirty-two percent had three. Thirty-four percent had no stones, 29.5% had one, and 36.2% had two on the left side. 52.9% of patients reported vomiting, 46.2% reported dysuria, and all patients complained lumbar pain. 74.3% of patients had a history of recurrent UTIs, and 88.6% of patients had hematuria. Merely 33.3% of patients adhered to their prescribed regimen.

When comparing patients with and without diabetes, the chi-square analysis revealed a number of statistically significant correlations. Positive family history ($\chi^2 = 23.33$, $p < 0.001$), hematuria ($\chi^2 = 6.77$, $p = 0.009$), and recurrent UTIs ($\chi^2 = 72.69$, $p < 0.001$) were all substantially more common in diabetics. There was also a higher likelihood of right hydronephrosis ($\chi^2 = 9.40$, $p = 0.002$), right renal parenchymal thinning ($\chi^2 = 72.69$, $p < 0.001$), right kidney size < 8 cm ($\chi^2 = 16.15$, $p < 0.001$), left hydronephrosis ($\chi^2 = 69.11$, $p < 0.001$), and left renal parenchymal thinning ($\chi^2 = 65.63$, $p < 0.001$) in diabetics. These results suggest that compared to non-diabetics, diabetic patients with nephrolithiasis typically have more severe renal structural alterations and a higher burden of urinary problems.

Table 1: *Demographic details of the participants*

Variable	Category	Frequency(n)	Percentage (%)	Mean ± SD / Range
Age (years)	-	210	100%	44.86 ± 14.01 (19 – 73)
Gender	Female	110	52.40%	
	Male	100	47.60%	
Diabetic (History)	Yes	105	50.00%	
	No	105	50.00%	
Duration of Stone (months)	-	210	100%	14.88 ± 10.28 (1 – 37)
Duration of Diabetes (yrs)	-	210	100%	4.72 ± 5.23 (0 – 16)
Family History of Stones	Yes	189	90.00%	
	No	21	10.00%	
Urine Crystals	Calcium Oxalate	98	46.70%	
	Uric Acid	112	53.30%	

Table 3: *Chi square test of association between diabetes status and various variables*

Variable	Chi-Square (χ^2)	df	p-value
Diabetic status*Family History	23.333	1	0
Diabetic status*Hematuria Present	6.774	1	0.009
Diabetic status*Recurrent UTI	72.692	1	0
Diabetic status*Right Hydronephrosis	9.403	1	0.002
Diabetic status*Right Renal Thinning	72.692	1	0
Diabetic status*Right Kidney Size <8cm	16.154	1	0
Diabetic status*Left Hydronephrosis	69.114	1	0
Diabetic status*Left Renal Thinning	65.625	1	0

Table 2: *Clinical, Laboratory and Radiological Findings*

Variable	Category	Frequency(n)	Percentage (%)	Mean ± SD / Range
HbA1c (%)	-	210	100%	7.17 ± 1.44 (4.8 – 9.5)
Hemoglobin (g/dL)	-	210	100%	13.23 ± 1.15 (11.3 – 15.4)
Creatinine (mg/dL)	-	210	100%	1.25 ± 0.40 (0.6 – 2.1)
Urine pH	-	210	100%	6.23 ± 0.44 (5.5 – 7.0)
Urine Pus Cells	-	210	100%	12.89 ± 5.22 (3 – 22)
Urine RBCs	-	210	100%	8.97 ± 4.20 (1 – 17)
Right Kidney Stones	1	67	31.90%	
	2	74	35.20%	
	3	69	32.90%	
Left Kidney Stones	0	72	34.30%	
	1	62	29.50%	
	2	76	36.20%	
Lumbar Pain	Yes	210	100.00%	
Dysuria	No	113	53.80%	
	Yes	97	46.20%	
Vomiting	No	99	47.10%	
	Yes	111	52.90%	
Hematuria Present	No	24	11.40%	
	Yes	186	88.60%	
Recurrent UTI	No	54	25.70%	
	Yes	156	74.30%	
Compliance with Treatment	No	140	66.70%	
	Yes	70	33.30%	
Right Kidney Hydronephrosis	No	9	4.30%	
	Yes	201	95.70%	
Right Renal Thinning	No	54	25.70%	
	Yes	156	74.30%	
Right Kidney Size <8cm	No	15	7.10%	
	Yes	195	92.90%	
Left Kidney Hydronephrosis	No	52	24.80%	
	Yes	158	75.20%	
Left Renal Thinning	No	50	23.80%	
	Yes	160	76.20%	
Left Kidney Size <8cm	No	18	8.60%	
	Yes	192	91.40%	
Urine Proteins	+	109	51.90%	
	++	101	48.10%	

Serum creatinine, HbA1c levels, and stone length all showed statistically significant differences between diabetes and non-diabetic patients, according to the independent samples t-test. Comparing diabetics to

Table 4: *Independent sample t-test between diabetes status and mean of variables*

Variable	Mean Difference	t	df	p-value	95% CI (Lower - Upper)
Duration of Stones (months)	-15.848	-17.547	137.036	< 0.001	-17.634 to -14.062
HbA1c (%)	-2.7019	-39.447	203.597	< 0.001	-2.8370 to -2.5669
Creatinine (mg/dL)	-0.6724	-23.358	182.846	< 0.001	-0.7292 to -0.6156

non-diabetics, the former had higher HbA1c levels (Mean Difference = -2.70, t(203.597) = -39.45, $p < 0.001$), higher serum creatinine levels (Mean Difference = -0.67 mg/dL, t(182.846) = -23.36, $p < 0.001$), and a significantly longer duration of stones (Mean Difference = -15.85 months, t(137.036) = -17.55, $p < 0.001$). These results point to a significant correlation between diabetes and deteriorating clinical markers in patients with nephrolithiasis.

Discussion

Given the expanding incidence of both diseases worldwide in recent years, there has been a growing interest in the connection between nephrolithiasis and diabetes mellitus.[9] With 210 kidney stone patients, half of whom had diabetes, this comparative cross-sectional study provides important new information on how diabetes affects the clinical and structural features of nephrolithiasis. By showing notable variations in stone burden, urine abnormalities, and renal structural alterations between diabetic and non-diabetic patients, the results complement and add to the body of current knowledge.

With a mean age of 44.86 years and a fairly equal distribution of genders, the demographic profile of this study is representative of the average adult population with nephrolithiasis. The study reported 50% diabetes prevalence is extremely high, highlighting how frequently both illnesses coexist. This is consistent with other study showing that insulin resistance and hyperglycemia produce a metabolic environment that is favorable to kidney stone formation, more than doubling the incidence of kidney stones in people with type 2 diabetic mellitus (T2DM).[10]

The prevalence of uric acid stones (53.3%) and calcium oxalate (46.7%) in urine analysis is consistent with known pathophysiological pathways in diabetes patients. Insulin resistance lowers renal ammonium production, which lowers urine pH and encourages the formation of uric acid stones.[11] Diabetics' generally more acidic urine, as seen in this study (mean urine pH 6.23), which promotes uric acid crystallization, may also be connected to the increased incidence of uric acid stones in this population.[12]

Diabetes appears to worsen renal impairment and the chronicity of stone illness, as seen by the study's result that diabetic individuals had significantly higher serum creatinine and HbA1c levels as well as longer stone duration.[13] This supports the finding by study that, in comparison to people without diabetes, diabetics typically have larger stones and more serious renal consequences.[14] The idea that metabolic dysregulation and hyperglycemia play a role in stone development and renal impairment is supported by the correlation between elevated stone burden and inadequate glycemic management (mean HbA1c 7.17%).[15]

The study's findings of a high 90% familial history of renal stones emphasize the interaction between genetics and environment in kidney stones disease, which may be more pronounced in those with diabetes.[16] Epidemiological evidence demonstrating familial clustering of kidney stones supports this, indicating that stone risk is increased by a genetic predisposition in conjunction with diabetes metabolic abnormalities.[17]

Clinically, the substantial morbidity linked to stones in diabetes patients is shown in the high incidence of hematuria (88.6%), recurrent UTIs (74.3%), and symptoms including vomiting and dysuria. The results of other study that show diabetes predisposes to more complex urinary tract pathology are consistent with the chi-square analysis that showed greater frequencies of hematuria, recurrent urinary tract infections, and hydronephrosis in diabetics.[18] Diabetics' lower kidney size and higher prevalence of renal parenchymal loss further suggest gradual structural damage brought on by ischemic injury and chronic hyperglycemia.[19]

In a study it is observed a higher mean stone size in diabetes patients and suggested routine ultrasound screening to minimize problems, which is consistent with the increased stone size and number in diabetics when compared to other observational studies.[20] Similarly, diabetics had considerably larger stones and higher comorbidities, such as hypertension and dyslipidemia, which may affect renal outcomes in concert.

The metabolic abnormalities seen, such as hyperuricosuria and acidic urine pH, are well-known risk factors for stone formation in type 2 diabetes.

These elements, along with insulin resistance and obesity, produce a pro-lithogenic milieu, which explains why diabetics have a higher incidence and severity of stones.[21] Furthermore, current research's mediation analysis highlights the systemic impact of this interaction by showing that diabetes contributes to the relationship between kidney stone development and cardiometabolic indicators.[16]

The study's low adherence rate (33.3%) to recommended regimens is alarming from the standpoint of clinical care since it could lead to poor glycemic control and stone recurrence. This emphasizes the necessity of integrated care solutions that emphasize lifestyle changes, diabetes management, and stone prevention techniques. Maintaining ideal blood sugar control, staying hydrated, making dietary changes (low sodium, moderate protein), and routinely checking for stone recurrence—especially in diabetic patients—are all evidence-based recommendations.[22,23]

This study uses a strong comparative cross-sectional design at a specialized tertiary care facility to successfully illustrate the relationship between diabetes mellitus and nephrolithiasis. Its validity is increased by using structured interviews, clinical examinations, and imaging, as well as by having a well-defined sample size (n=210). Findings are more reliable when both quantitative and categorical variables are included, along with the proper statistical methods (t-tests, chi-square tests). In-depth clinical, biochemical, and structural comparisons between patients with and without diabetes are also provided by the study. Significant relevance is added for regional healthcare strategies and additional research into diabetic urological problems due to its real-world setting with particular emphasis on a Pakistani population.

The study contains a number of shortcomings in spite of its advantages. Its single-center cross-sectional design restricts the data' capacity to be broadly applied and causally inferred. Selection bias may be introduced when non-probability consecutive sampling is used. Dependence on self-reported history, such as compliance and duration of diabetes, also raises the possibility of recall bias. Longitudinal follow-up, which might evaluate results over time, is absent from the study. Confounding variables like nutrition, hydration, exercise, and co-occurring drugs were also not managed. Finally, the evaluation of glycemic control and recurrence of stones may have been impacted by the low (33.3%) adherence to therapy.

Conclusion

This comparative cross-sectional investigation shows that diabetic individuals had greater renal structural alterations, more severe stone disease, and more urinary problems than non-diabetics, supporting the substantial correlation between diabetes mellitus and nephrolithiasis. In order to lessen the burden of stones and maintain renal function in diabetic populations, future studies should concentrate on longitudinal designs to clarify causative pathways and assess therapies aimed at metabolic control.

Ethical Approval: The IRB/EC approved this study via letter no. 626/IREF/RMU/2024 dated February 15, 2024.

Conflict of Interest: None

Funding Source: None

Authors' Contribution

MN: Conception.

SG, MRM: Design of the work.

US, SMAK, QUA: Data acquisition, analysis, or interpretation.

SG, US, SMAK, QUA: Draft the work.

MN, MRM: Review critically for important intellectual content.

All authors approve the version to be published.

All authors agree to be accountable for all aspects of the work.

References

1. Saeed S, Ullah A, Ahmad J, Hamid S. The Prevalence of Incidentally Detected Urolithiasis in Subjects Undergoing Computerized Tomography. Cureus. 2020;12(9): e10374.
2. Balasubramanian P, Wanner C, Ferreira JP, Ofstad AP, Elsaesser A, Zinman B, et al. Empagliflozin and Decreased Risk of Nephrolithiasis: A Potential New Role for SGLT2 Inhibition? J Clin Endocrinol Metabol. 2022;107(7):E3003–7.
3. Alelign T, Petros B. Kidney Stone Disease: An Update on Current Concepts. Adv Urol. 2018; https://doi.org/10.1155/2018/3068365
4. Akhtar D, Farooq SMY, Khalid T, Yaseen K, Nazir A, Miraj K, et al. Incidence Of Kidney Stones in Diabetic and Non-Diabetic Patients on Ultrasound: Kidney Stones in Diabetic and Non-Diabetic Patients. Pak J Health Sci. 2022;3(04):09–12.

5. Khalili P, Jamali Z, Sadeghi T, Esmaeili-nadimi A, Mohamadi M, Moghadam-Ahmadi A, et al. Risk factors of kidney stone disease: a cross-sectional study in the southeast of Iran. BMC Urol. 2021;21(1):141.
6. Bokhari A, Alghamdi AAM, Khushayl AMA, Alaklabi SNA, Albarrak SKA, Aldarwish HA. Prevalence and Risk Factors of Renal Stones Among the Bisha Population, Saudi Arabia. Cureus. 2023;15(6):e40090.
7. Meydan N, Barutca S, Caliskan S, Camsari T. Urinary stone disease in diabetes mellitus. Scand J Urol Nephrol. 2003;37(1):64–70.
8. Diabetes. [cited 2026 Jul 11]. Available from: https://www.who.int/health-topics/diabetes
9. Prasanchaimontri P, Monga M. Predictive Factors for Kidney Stone Recurrence in Type 2 Diabetes Mellitus. Urology. 2020;143:85–90.
10. Shen Y, Zhu Z, Bi X, Shen Y, Shen A, Deng B, et al. Association between insulin resistance indices and kidney stones: results from the 2015–2018 National Health and Nutrition Examination Survey. Front Nutr. 2024;11:1444049.
11. Spivacow F, Valle E, Rey P, Allo P, Pailler M. Kidney stones in patients with type 2 diabetes mellitus. Metabolic risk factors. Med Res Arch. 2023;11(10):e4483.
12. Pricop C, Ivănuță M, Nikolic M, Puia D. Kidney Stones of Type I vs. Type II Diabetic Patients: Are There Any Differences? J Clin Med. 2024;13(20):-6110.
13. Almuhanna NR, Alhussain AM, Aldamanhori RB, Alabdullah QA, Almuhanna NR, Alhussain AM, et al. Association of Chronic Hyperglycemia With the Risk of Urolithiasis. Cureus. 2023;15(10):e47385.
14. Nafadi IB, Alsulami AA, Halabi NF, Alsubhi AA, Maghrabi SW, Alshehri WS, et al. Kidney stone characteristics in diabetics versus nondiabetics at a tertiary care center in Saudi Arabia. Urol Ann. 2025;(1):26–31.
15. Lien TH, Wu JS, Yang YC, Sun ZJ, Chang CJ. The Effect of Glycemic Status on Kidney Stone Disease in Patients with Prediabetes. Diabetes Metab J. 2016;40(2):161.
16. Yin G, Zhang W, Zhang J, Sheng T, Chen B. Diabetes mediates the relationship between cardiometabolic index and kidney stones: a cross-sectional study. Sci Rep. 2024;14(1):31075.
17. Chang CW, Ke HL, Lee JI, Lee YC, Jhan JH, Wang HS, et al. Metabolic syndrome increases the risk of kidney stone disease: A cross-sectional and longitudinal cohort study. J Pers Med. 2021;11(11):-1154.
18. Blair Y, Wessells H, Pop-Busui R, Ang L, Sarma A V. Urologic complication in diabetes. J Diabetes Complications. 2022;36(10):108288.
19. Kaur A, Sharma GS, Kumbala DR. Acute kidney injury in diabetic patients: A narrative review. Medicine (United States). 2023;102(21): e33888.
20. Zulfiqar M, Shabbir H, Kanwal I, Zafar F, Taj A, Nadeem M, et al. Sonographic Assessment of Nephrolithiasis in Patients of Type II Diabetes in the 30 to 50 Year Age Group. J Health Med Sci. 2019;2(4):546-51.
21. Mohammed E, Salmi I Al, Riyami D Al, Khan S, Riyami M Al, Rahbi F Al, et al. Non-Diabetic Kidney Disease in Type 2 Diabetes Mellitus: A Study of 82 Patients and Review of the Literatures. Open J Nephrol. 2022;12(1):169–86.
22. Hadi A, AlAteeq MA, Hadi A, AlAteeq MA. Level of Control of Dyslipidemia Among Patients Followed in Family Medicine Clinics in Riyadh, Saudi Arabia. Cureus. 2021;13(6):e15504.
23. Béjar R, Suleiman-Martos N, Lubawy M, Formanowicz D. Insulin Resistance and Urolithiasis as a Challenge for a Dietitian. International Journal of Environment Res Public Health. 2022;19(12):7160.