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# UROLITHIASIS: A COMPREHENSIVE STUDY ON PREVALENCE, RISK FACTORS, CLINICAL PRESENTATION, AND STONE CHARACTERISTICS

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## Abstract

Urolithiasis, a common condition in Pakistan, has seen a recent decline in prevalence due to improved living standards. Major causes include structural abnormalities and metabolic disorders. The study was conducted at Tertiary care Hospitals, Peshawar with 1450 participants from November 2022 to March 2023, revealed risk factors like Rice (72%), Carbonated Drinks (67%), Spinach (53%), Potato (92%), Pulses (82%), Smoking (43%), and Sweets (100%). Clinical symptoms included abdominal pain (81%), vomiting (53%), and urination pain (76%), blood in urine (83%), nausea (97%), fever (85%), polyuria (63%), pyuria (59%), hematuria (54%), and dehydration (23%). Blood group analysis showed B+ (45.3%) and O+ (32%) as most prevalent, with a strong correlation ($r_s = 0.96429$, $p = 0.00045$) between blood group and urolithiasis. Stone composition included Ca. Oxalate (623), amorphous crystals (128), and Ca. Phosphate (521). Location-wise, 351 had Ureteral, 27 Renal-pelvic, 67 Calyx, and 78 Calyceal stones. Stone types included 359 Ca. Oxalate, 112 Uric Acid, 34 Cysteine, and 118 Ca. Phosphate. Sizes varied: 3mm (374 cases, Mean ± SD: 68.5±27.3), 4mm (187 cases, Mean ± SD: 46.7±12.4), 6mm (43 cases, Mean ± SD: 10.7±4.38), and 7mm (19 cases, Mean ± SD: 4.7±3.74). A randomized clinical trial is recommended for a precise evaluation of prophylactic interventions versus an anticipatory approach.

**Keywords:** Urolithiasis, ultrasonography, lith-size, crystals-stone, Tertiary care Hospitals, Peshawar

## Introduction

Urolithiasis is thought to be one of the most common urinary tract diseases in Asia (1). The number of people who have kidney stones, how often they get them, and what they are made of vary all over the world and have changed over the past few years. People from all over North America, Europe, and Asia seem to have kidney stones (2). The differences between countries are caused by geological factors like (age, education level, occupation, gender, socioeconomic status, fluid intake, climate, dietary habits racial or national distribution, genetic disease, and metabolic disease)(3). The goal of this study is to give an up-to-date look at the epidemiology of urolithiasis in Asia and find out which factor is most important in the formation of stones (4). The ureters, the bladder, and the urethra are the components that make up this system. Urolithiasis is treatable in many patients with expectant management, the use of analgesics, and the administration of antiemetic medicines (5). Patients who have stones that are associated with blockage, renal failure, and infection, however, require additional therapy that is increasingly more intensive(6).

## Methodology

### Study Design

The study was designed at the Department of Biotechnology and Genetic Engineering, Hazara University, in collaboration with the Department of Urology & Nephrology Tertiary care Hospitals, Peshawar.

### Study area

The study was conducted at the Department of Urology & Nephrology Tertiary care Hospitals, Peshawar.

### Patients Appointment calendar

All the patients made an appointment with their concerned medical specialist for the examination of urolithiasis. They were examined from March 2022 to August 2022.

### Permission and consents

Consent forms were filled out by each patient before the study. The consent form comprises health status, personal information, and daily practices.

### Clinical consideration

We isolated patients' medical and health information in the presence of patients and concerned medical specialists. Concerned medical specialists examined the patients and also share valid information with us to proceed with the study up.

### History and Medical record

We used patient history and medical records during our study with the help of concerned medical specialists and patients. Concerned medical specialists strictly disallow sharing the patient history and medical records on any platform under the rule of the Ethical and Medical Board of the Department of Biotechnology and Genetic Engineering, Hazara University, and the Department of Urology & Nephrology, Tertiary care Hospitals, Peshawar.

### Diagnosis and Testation

We used different types of the specimen of patients in the study such as urine, blood or serum. All of these specimens were recommended by concerned specialists to evaluate and confirm the urolithiasis indication.

### Imaging and sonography

We used the patient’s ultrasonography examined by the concerned radiologist as well as medical specialists. Ultrasonography reports of the patients were evaluated for necessary information such as

size, location and type of urolithiasis under the supervisor of the radiologist and concerned medical specialist.

**Urinalysis (FUS-1000)**
We used DIRUI (FUS-1000) for the analysis of sedimentation and microscopy. FUS-1000 analyzer can run many samples at once. FUS-1000 has good specificity and sensitivity rate throughout the span. FUS-1000 has good quality control evaluation and stability. Before pushing the study samples, we ruined QCs (quality control) provided by the Laboratory of Urology & Nephrology, Tertiary care Hospitals, Peshawar.
(7).

**Olympus CX-21**
We used a microscope (Olympus CX-21) to cross-check or repeat the complicated or urolithiasis-indicated samples such as RBCs, WBCs, Crystals and Casts. Olympus CX-21 is a good quality scientific instrument with multi-magnification power such as 40x. We used 40x magnification power for the visualization of the urine components such as RBCs, WBCs, Crystals and Casts (8).

**Combur-10 (Roche®)**
The Combur-10 test taken from Roche® was utilized for deciding 10 different urine chemical parameters. Its exceptional plan keeps the blending of the reagents from various test regions. The Combur-10 test strips are extremely delicate and respond to even the littlest chemical changes. This takes into consideration an exceptionally exact urinalysis while searching for blood, glucose, protein, nitrite and bilirubin etc. FUS-1000 had a light transmitter for the reading of the Combur-10 strips in a few seconds, after reading FUS-1000 displayed the quality of the chemical detected in the urine sample of the patient (9).

**Approval recording**
We received approval latter from the Department of Biotechnology and Genetic Engineering, Hazara University as well as the Research Ethics Review Committee of Tertiary care Hospitals, Peshawar.

**Data publication**
All information about patients related to health, ethnicity, culture and medical condition is kept as a personal asset of the patient in the Department of Medical Depository purposes. We release the permission for the publication of data anywhere in the world for the refinement of the research and medical updates.

**Statistical analysis**
We used SPSS 2.0 for the analysis of variables to find out the Mean ± SD, Spearmen's Rho correlation, Percentage and frequency of the patient data.

**Inclusion criteria**
Active signs & symptoms of kidney, urolithiasis patients, diabetic and non-diabetic patients.

**Exclusion criteria:** lithotripsy patients, kidney transplant patients, surgery patients, and pregnant women.

**Results**
**Clinical examination**
The study was conducted at department of Urology & Nephrology, Tertiary care Hospitals, Peshawar. A total of n=1450 attended the consultant appointment from November 2021 to July

2022. The male n=1270, and female n=180 made an appointment with a concerned medical specialist (fig. no.1).

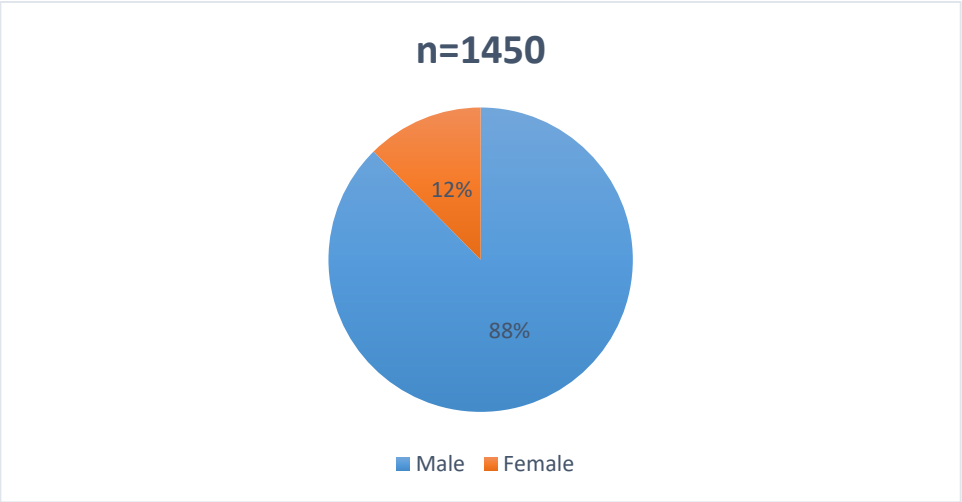


**Figure 1:** Gender-wise appointments scheduled by the patient

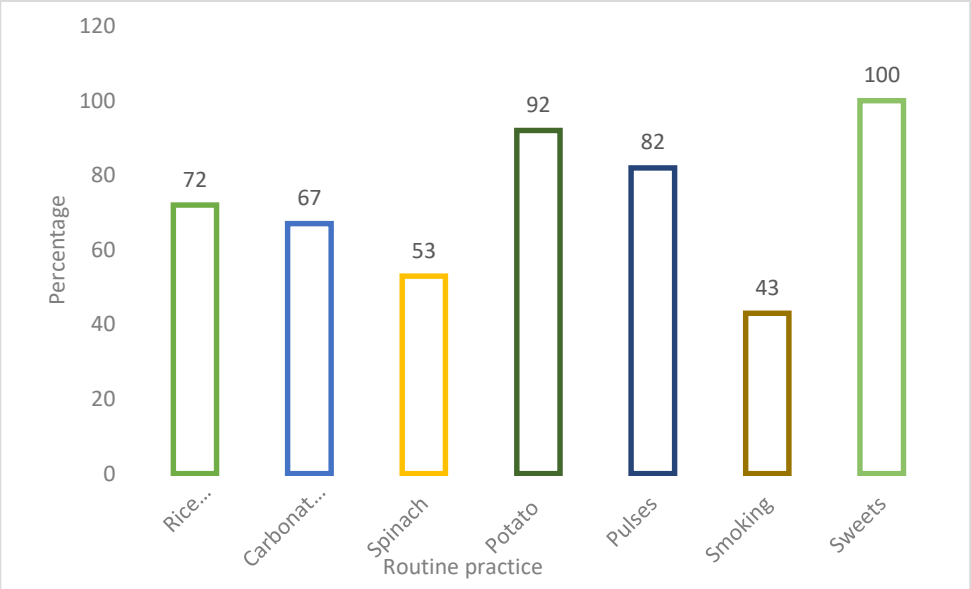


**Figure 2:** Routine practices predicted as Urolithiasis indicators

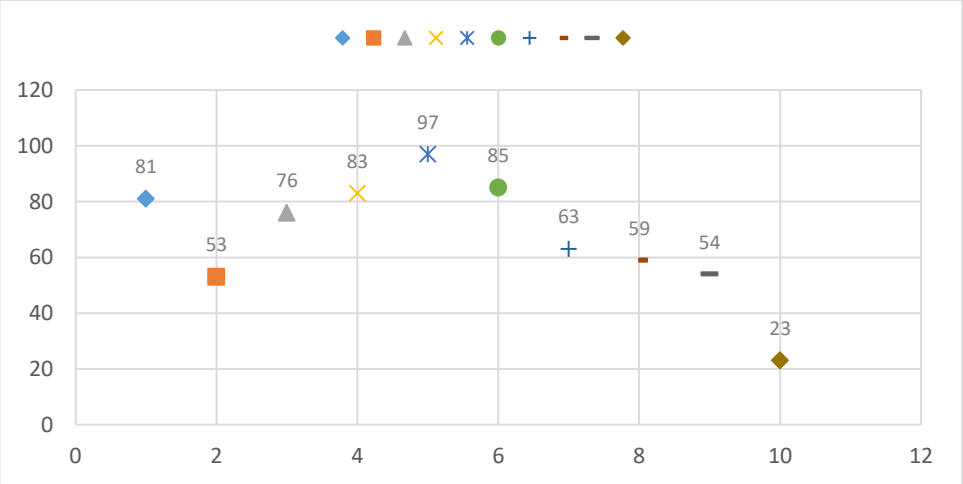


**Figure 3:** Checklist prophesied in patients with Urolithiasis

## Clinical diagnosis

### Blood-group relevancy to Urolithiasis

**Table 1:** Blood group relevancy to urolithiasis

| Blood Groups | n=1450 | Percentage (1450) | Urolithiasis Diagnosed (n=623) | Percentage (n=623) | Spearman's Rho | p-(two-tailed) |
|---|---|---|---|---|---|---|
| **A+** | 132 | 9.1 | 34 | 5.45 | $r_s$ = 0.96429 | 0.0045** |
| **B+** | 657 | 45.3 | 401 | 64.3 | | |
| **AB+** | 79 | 5.44 | 27 | 4.3 | | |
| **O+** | 464 | 32 | 145 | 23.2 | | |
| **A-** | 62 | 4.27 | 5 | 0.80 | | |
| **B-** | 43 | 2.96 | 11 | 1.76 | | |
| **O-** | 13 | 0.89 | 0 | 0 | | |

****Blood group variables were statistically significant.**

### Urinalysis profile

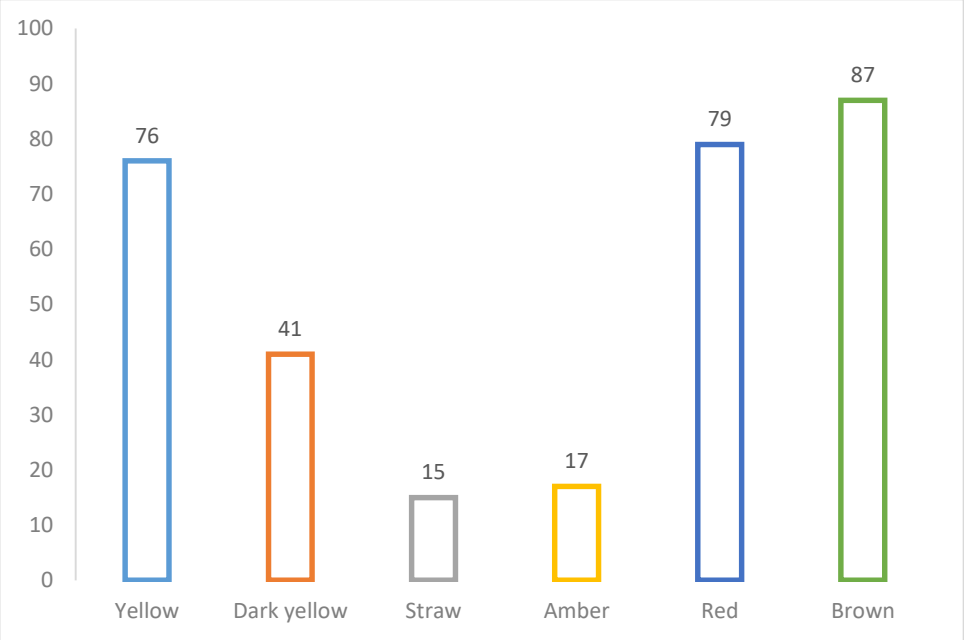


**Figure 4:** profile of urine texture

**Table 2:** Microscopic examination of Urine

| Urine Cells | Measurement Units on 40x magnification power | | | |
|---|---|---|---|---|
| | **10-20/HPF** | **20-30/HPF** | **Numerous/HPF** | |
| **RBC** | 721 | 413 | 316 | **Not seen** |
| **WBC** | 803 | 519 | 128 | |
| **Urine Casts** | | | | |
| **Cast type** | Few | Moderate | Many | None |
| **Hyaline** | 312 | 78 | 16 | 1044 |
| **Granular** | 117 | 53 | 19 | 1261 |
| **WBC casts** | 790 | 354 | 306 | 0 |
| **Urine Crystals** | **Measurement Units** | | | |
| | Few | Moderate | Many | None |
| **Cysteine** | 92 | 212 | 57 | 1089 |
| **Ca. Oxalate** | 623 | 578 | 108 | 141 |
| **Mucus** | 911 | 219 | 320 | 0 |
| **Amorphous** | 128 | 93 | 234 | 995 |
| **Ca. Phosphate** | 521 | 437 | 125 | 367 |

***ca. (calcium), HPF (high power field)**

## Biochemical parameters assessment

**Table 3:** Correlation of biochemical parameters in Urolithiasis and Non-urolithiasis patients

| Urolithiasis | | Non-urolithiasis | Units | Spearman's Rho | p-(two-tailed) |
|---|---|---|---|---|---|
| Blood Parameter | Mean± SD | Mean ± SD | | | |
| **Urea** | 63±7 | 43±4 | mg/dL | $r_s$ = 0.99403 | 0.001** |
| **Creatinine** | 1.26±0.3 | 0.86±0.12 | | | |
| **Uric Acid** | 6.5±1.6 | 4.5±0.72 | | | |
| **SGPT** | 53±4.2 | 42±3.7 | U/L | | |
| **AST** | 52±7 | 39±6 | | | |
| **ALP** | 137±14.6 | 113±9.2 | | | |
| **Albumin** | 6.5±3.1 | 3.5±1.2 | g/dL | | |
| **Glucose Level** | 218±17.5 | 93±5 | mg/dL | | |

>AST (aspartate aminotransferase), ALT (alanine aminotransferase), mg/dL (milligrams per deciliter), U/L (units per liter), g/dL (gram per deciliter), **variable statistically significant.

## Ultrasonography examination

**Table 4:** Ultra-sonographic evaluation of patient

| Urolithiasis location by ultrasonography (n=623) | | Urolithiasis Type | n=623 | Spearman's Rho | p-(two-tailed) |
|---|---|---|---|---|---|
| **Ureteral Stone** | 351 | Ca. Oxalate | 359 | $r_s$ = 0.8 | p = 0.2 |
| **Renal pelvic stone** | 127 | Uric acid | 112 | | |
| **Calyx stone** | 67 | Cysteine | 34 | | |
| **Calyceal stone** | 78 | Ca. Phosphate | 118 | | |

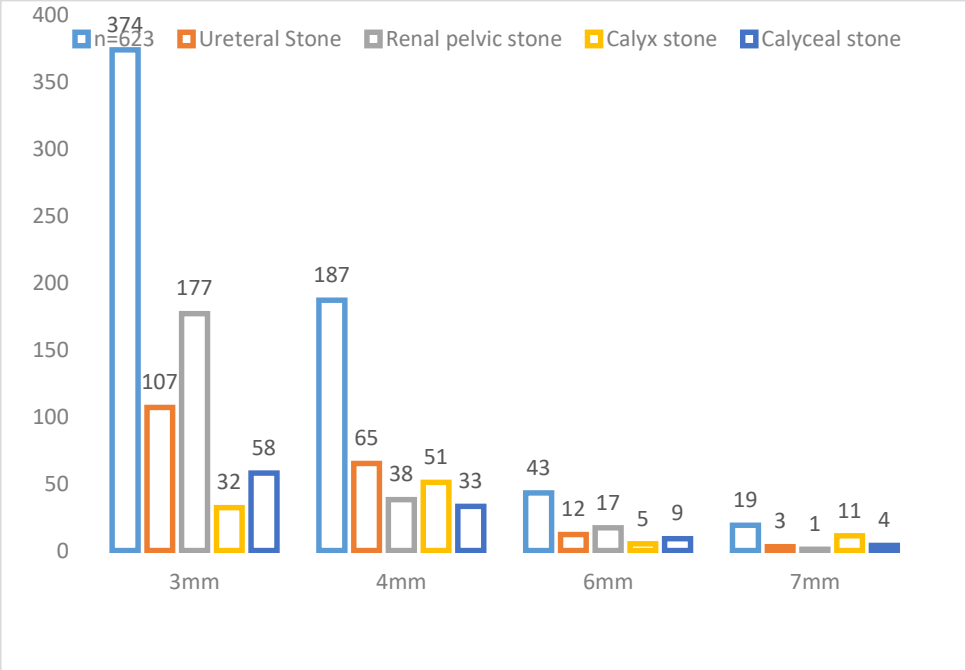


**Figure 5:** measurement of urolithiasis size (millimeter)

**Table 5:** Classification of urolithiasis based on size and organ location by a concerned medical specialist

| Stone size | n=623 | Ureteral Stone | Renal pelvic stone | Calyx stone | Calyceal stone | Mean ± SD |
|---|---|---|---|---|---|---|
| **3mm** | 374 | 107 | 177 | 32 | 58 | 68.5± 27.3 |
| **4mm** | 187 | 65 | 38 | 51 | 33 | 46.7± 12.4 |
| **6mm** | 43 | 12 | 17 | 5 | 9 | 10.7± 4.38 |
| **7mm** | 19 | 3 | 1 | 11 | 4 | 4.7± 3.74 |

**Discussion**

we followed the concerned medical examination and history pattern for analysis of the risk factor, routine practices that were associated with Urolithiasis such as Rice addiction 72%, Carbonated Drinks 67%, Spinach 53%, Potato 92%, Pulses 82%, Smoking 43%, Sweets 100% with 95% of confidential level (Cl), $1.960\sigma_{\bar{x}}$, 72.7143 ±14.021 (±19.28%) (fig. no.2).

The health checklist of patients has been scheduled with the concerned medical specialist for routine clinical examination such as abdominal pain 81%, vomiting 53%, urination pain 76%, blood in urine 83%, nausea 97%, fever 85%, polyuria 63%, pyuria 59%, hematuria 54%, and dehydration 23% with 95% of confidential level (Cl), $1.960\sigma_{\bar{x}}$, 67.4 ±12.606 (±18.70%) (fig. no.3). Diabetic profile of the patients also evaluated on early priority such as Diabetic patients n=321 and Non-diabetic patients n=1129.

Additionally, the patients tested for blood grouping examination such as A+ 132, (9.1%), B+ 657, (45.3%), AB+ 79, (5.44%), O+ 464, (32%), A- 62, (4.2%), B- 43, (2.9%), and O- 13, (0.8%). While we evaluated most repeated relevance blood group for urolithiasis or nephrolith such as A+ 34, (5.4%), B+ 401, (64.3%), AB+ 27, (4.33%), O+ 145, (23.2%), A- 5, (0.80%), B- 11, (1.7%), and O- 0, (0.0%). Also calculated Spearman's Rho correlation of relevance blood group for urolithiasis or nephrolith rs = 0.96429, p-(two-tailed) =0.00045 (table no.1).

Spot urine samples were sufficient for the usual metabolic assessment of stone precursors, with a margin of error imposed by connecting variables to urea. This is because major collection errors necessitate discarding a third of all 24-hour urine samples. Urine testing on the spot is able to work around this problem. The relevance of a single specimen is questioned due to the existence of daily variance; therefore, it is suggested that three spot urine test be acquired (10).

A sum of 1450 patients screened for the urinalysis as recommended by the concerned medical specialist as the physical texture of the sample was yellow 76%, Dark yellow 41%, Straw 15%, Amber 17%, Red 79%, and Brown 87% (fig. no.4). Chemical composition of samples were scaled such as Average Gravity 1.010, PH 7.5, Leukocyte esterase ++, and Albumin ++. Microscopic examination suggested such as red blood cells 721 in the range of 10-20/HPF, 413 in the range of 20-30/HPF, and 316 in the range of numerous/HPF. The white blood cells were observed as 803 in the range of 10-20/HPF, 519 in the range of 20-30/HPF, and 128 in the range of numerous/HPF. The casts such as Hyaline were seen in 312 in the range of 0-5/HPF, 78 in the range of 5-10/HPF, and 16 in the range of 10-20/HPF while no hyaline casts were seen in 1044. The Granular casts were seen in 117 in the range of 0-5/HPF, 53 in the range of 5-10/HPF, and 19 in the range of 10-20/HPF while no granular casts were seen in 1044. Whereas crystals such as cysteine were seen in 92 in the range of few, 212 in the range of moderate, 57 in the range of many and no crystal seen in 1089. Ca. Oxalate in 623 in range of few, 578 in range of moderate, 19 in range of many and no crystal seen in 1261. Amorphous crystals in 128 in the range of few, 93 in the range of moderate, 234 in the range of many and no crystal was seen in 995. Ca. Phosphate in 521 in the range of few, 437 in the range of moderate, 125 in the range of many and no crystal was seen in 367 (table no.2).

The disease burden is significantly increased when one takes a preventative approach to asymptomatic kidney diseases. The vast majority of patients who had a severe event were found to have spontaneously passed their stones 48 percent while 27 percent of the total of individuals needed urinary procedure and 27 percent of total of patients were scheduled for clinical surgical treatment. Even though ultrasound preventive shock wave lithotripsy was believing that the key always a risk-free procedure (11).

All the scheduled patients were screened for different types of blood parameters such as renal function and liver function tests. Later, they were classified into two groups such as urolithiasis patients n=623, and non-urolithiasis patients n=827. Patients with urolithiasis (n=623) screened for blood parameters such Urea with average mean 63mg/dL, creatinine 1.26 mg/dL, uric acid 6.5 mg/dL. ALT 53U/L, AST 52U/L, ALP 137U/L, albumin 6.5 and Glucose 218. Whereas, Non-urolithiasis patients (n=827) screened for blood parameters such Urea with average mean 43mg/dL, creatinine 0.86 mg/dL, uric acid 4.5 mg/dL. ALT 42, AST 39, ALP 113, albumin 3.5 and Glucose

93. Also calculated was Spearman's Rho correlation of blood parameters for urolithiasis and non-urolithiasis rs = 0.99403, p-(two-tailed) =0.000 (table no.3).
The prevalence of hydro-nephrotic and kidney stone disease, as confirmed by roentgenography. The Swedish urban district was analyzed for the years (1953–1955 and 1968–1970) in light of the anecdotal data suggesting a rise in the number of individuals suffering from severe kidney constipation. This was done in light of the fact that the prevalence of hydro-nephrotic and kidney stone disease was confirmed by roentgenography (12).
After urinalysis examination and biochemical profile indication, the concerned medical specialist recommended ultrasonography of the kidneys to identify the stone type, stone size and location of the stone. Concern medical specialist remark that 351 has Ureteral-location, 27 has Renal-pelvic location, 67 had Calyx-location, and 78 had Calyceal-location. Also identified 359 had ca. oxalate stone, 112 had uric acid stone, 34 had cysteine, and 118 had ca. phosphate.

Concerned medical specialists examined the ultrasonography of the patient for urolithiasis size such as 374 ultra-sonographies reports evaluated for 3mm in size and classified as 107 Ureteral stone, 177 Renal-pelvic stone, 32 Calyx stone, and 58 Calyceal stone(fig. no.5). The Mean ± SD (68.5± 27.3) whereas Cl 95%, $1.960\sigma_{\bar{x}}$ 68.5 ±26.825 (±39.16%). 187 the ultra-sonographies report evaluated for 4mm in size classified as 65 Ureteral stones, 38 Renal-pelvic stones, 51 Calyx stones, and 33 Calyceal stones. The Mean ± SD (46.7±12.4)) whereas Cl 95%, $1.960\sigma_{\bar{x}}$ 46.75 ±12.169 (±26.03%). 43 ultra-sonographies report evaluated for 6mm in size classified as 12 Ureteral stones, 17 Renal-pelvic stones, 5 Calyx stones, and 9 Calyceal stones. The Mean ± SD (10.7±4.38) whereas Cl 95%, 10.75 ±4.293 (±39.93%). 19 ultra-sonographies report evaluated for 7mm in size classified as 19 Ureteral stones, 3 Renal-pelvic stones, 11 Calyx stones, and 4 Calyceal stones. The Mean ± SD (4.7±3.74) whereas Cl 95%, 4.75 ±3.691 (±77.71%) (Table no.5).
They were able to demonstrate that the prevalence of greater chronic renal stone disease has grown from 0.5 to 0.8%c9 in women and from 3.4 to 4.4 in a sample of 986 to 1030 outpatients. In general, we discovered that the prevalence of acute urolithiasis increased by a factor of fifty percent between the time periods of 1.5 and 2.4 that were studied. The findings' implications for familial hyperparathyroidism were highlighted (13).

## Conclusion

Urolithiasis is still one of the most common clinical conditions affecting males and females in Pakistan, while its prevalence has been declining recently due to better living standards. There are several potential causes of urolithiasis, but structural abnormalities and metabolic disorders are major contributors. A randomized clinical trial is required in order to conduct an accurate evaluation of the value of prophylactic interventional procedures in comparison to an anticipatory approach

## Authors Contributions

**Awais Khan &Muhammad Nabeel:** Data collection, Data curation, Editing, Writing the first draft, supervision; **Sumbal Nosheen & Assad Rehman**: Study design, Data analysis, Editing; **Aamna Shah**: Data analysis, Data curation, Editing; **Hira Hassan**: Data analysis, Editing. **Zulfiqar Ali Abdul Sattar**: Study design, Data analysis; **Awais Khan**: Data collection, Data curation

## References

1. Bartges JW, Callens AJJVCSAP. Urolithiasis. 2015;45(4):747-68.
2. Türk C, Petřík A, Sarica K, Seitz C, Skolarikos A, Straub M, et al. EAU guidelines on interventional treatment for urolithiasis. 2016;69(3):475-82.
3. Zampini A, Nguyen AH, Rose E, Monga M, Miller AWJSr. Defining dysbiosis in patients with urolithiasis. 2019;9(1):1-13.
4. Thakore P, Liang TH. Urolithiasis. StatPearls [Internet]: StatPearls Publishing; 2021.

5. Jobs K, Rakowska M, Paturej AJJom, child. Urolithiasis in the pediatric population− Current opinion on epidemiology, patophysiology, diagnostic evaluation and treatment. 2018;22(2):201-8.
6. Abou Chakra M, Dellis AE, Papatsoris AG, Moussa MJEoop. Established and recent developments in the pharmacological management of urolithiasis: an overview of the current treatment armamentarium. 2020;21(1):85-96.
7. Sonmez MG, Kozanhan B, Deniz ÇD, Iyisoy MS, Kilinc MT, Ecer G, et al. Dynamic thiol/disulfide homeostasis as a novel indicator of oxidative stress in patients with urolithiasis. 2019;60(4):258-66.
8. Wiraswesty I, Respati SH, Sulistyowati S, Priyanto HJIJoM. The effect of neoadjuvant chemotherapy on HIF-1α expression in cervical uterine cancer. 2018;3(2):119-24.
9. Gupta V, Adhikari K, Kumar MJMRC. Utility of simple dipstick test in diagnosing urinary tract infection in children presenting with fever: A prospective observational study. 2022;9(1):69-77.
10. Suzuki I, Ogawa M, Seino K, Nogawa M, Naito H, Yamakoshi K-i, et al. Reagentless estimation of urea and creatinine concentrations using near-infrared spectroscopy for spot urine test of urea-to-creatinine ratio. 2018;7:72-81.
11. Heo J, Son J, Lee WJS, Work Ha. Epidemiology of Urolithiasis with Sex and Working Status Stratification Based on the National Representative Cohort in Republic of Korea. 2022.
12. Chen VY, Chen YJCUAJ. The first epidemiology study of urolithiasis in New Brunswick. 2021;15(7):E356.
13. Kopecny L, Palm CA, Segev G, Westropp JLJJovim. Urolithiasis in dogs: Evaluation of trends in urolith composition and risk factors (2006-2018). 2021;35(3):1406-15.