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Prevalence, Management, and Associated Risk Factors of Urolithiasis among Patients in a Tertiary Care Hospital, Bathinda

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Abstract

Background: Urolithiasis, a prevalent condition affecting the urinary system, is defined by the production of mineral crystals in the renal system or urinary tract. The purpose of this study is to assess the prevalence, demographic distribution, prognostic variables, and management findings among patients with urolithiasis at Adesh Hospital in Bathinda.

Methods: A six-month prospective observational study was conducted in the Department of Urology. The study comprised 170 individuals with urolithiasis. Data were collected on socio-demographic details, clinical history, risk factors, laboratory and radiological findings, treatment regimens, and therapeutic outcomes. Statistical analyses were performed to identify patterns and associations.

Results: Among 1432 patients screened, the prevalence of urolithiasis was 11.8%. The condition was most prevalent in the 38–48 age group (26.5%), with a slight female predominance (52.4%). Stone sizes of 4–8 mm were most common (61.8%), and the interpole calyx was identified as the predominant stone site (34.1%). Calcium stones were the most frequent composition (77.1%). Risk factors included inadequate hydration (62.9%), high sodium intake (79.4%), obesity (40.6%), alcohol use (53.5%), and frequent NSAID use. Hypertension (28.2%) and fatty liver (22.4%) were notable comorbidities, with a family history present in 8.2% of cases.

Treatment: Medical management primarily involved urinary alkalinizers like potassium citrate and citric acid (98.2%) and alpha-blockers such as tamsulosin (40.0%). Antibiotics, including levofloxacin (41.8%) and cefixime with potassium clavulanate (32.9%), were frequently prescribed. Rabeprazole with domperidone (64.1%) was the most utilized proton pump inhibitor. Significant symptom improvement was observed post-treatment, particularly in dysuria, urinary retention, hematuria, and straining ($p < 0.001$).

Conclusion: Urolithiasis is a significant health issue influenced by modifiable lifestyle factors and comorbidities. This study underscores the importance of early diagnosis, effective medical management, and patient education to address underlying risk factors. The findings provide valuable insights for improving clinical outcomes and guiding evidence-based treatment strategies for urolithiasis.

Keywords: Urolithiasis, Prevalence , Risk Factors , Management Practices

Introduction

Urolithiasis, characterized by the formation of calculi in the urinary system, is a common and burdensome condition globally. These urinary calculi, or stones, are crystalline aggregations that form due to imbalances in the concentrations of urine solutes that promote and inhibit crystallization. This disorder has historical significance, with evidence of urinary stones found in Egyptian mummies dating back to 4800 B.C. and in archaeological sites in various cultures, including Native American and Indian tombs. Although advances in healthcare research, urolithiasis remains a serious global health burden.

The global prevalence of urolithiasis is estimated at approximately 12%, with recurrence rates as high as 81% in males and 60% in females. The condition is multifactorial, involving genetic, environmental, and lifestyle-related risk factors. Key contributors include dehydration, dietary habits (such as high sodium or calcium intake), obesity, and underlying comorbidities such as hypertension and metabolic disorders. Gender differences are evident, with males historically at greater risk, though recent data indicate a rising prevalence among females. Geographically, urolithiasis exhibits variability, with higher rates in industrialized and arid regions.

The formation of urinary calculi involves complex physiochemical processes such as supersaturation, nucleation, crystal growth, aggregation, and retention in renal tubular cells. These processes are influenced by abnormalities in urinary chemistry, such as hypercalciuria, hyperoxaluria, or hypocitraturia, often exacerbated by dietary and metabolic factors. Kidney stones vary in size, composition, and location.The most prevelent stone globally are calcium oxalate stones. Other types include calcium phosphate, uric acid, and cystine stones, each with distinct etiologies and risk factors.

In India, particularly in regions like Bathinda, Punjab, dietary habits, climatic conditions, and lifestyle factors contribute to the high prevalence of urolithiasis. The region's hot climate promotes dehydration, a significant risk factor for stone formation. Additionally, the dietary patterns, including high salt and protein intake, exacerbate the risk of stone formation. This study is critical for understanding the local prevalence, risk factors, and management practices associated with urolithiasis in Bathinda, thereby enabling targeted interventions and improved clinical outcomes.

Objectives

Primary Objective:

- To determine the prevalence of urolithiasis.

Secondary Objectives:

- To evaluate the effectiveness of current management practices for urolithiasis.
- To identify associated risk factors contributing to the development of urolithiasis.

This research aims to bridge gaps in knowledge regarding urolithiasis in Bathinda, a region with unique environmental and dietary challenges. By identifying local prevalence rates, associated risk factors, and treatment outcomes, this study seeks to inform evidence-based strategies for prevention, early diagnosis, and effective management of urolithiasis. Furthermore, it highlights the importance of lifestyle modifications and patient education in mitigating the disease burden.

Methodology

This prospective observational study aimed to determine the prevalence, risk factors, and management practices associated with urolithiasis in patients visiting the General Surgery Department of Adesh Hospital, Bathinda. The study, approved by the AIPBS College Research Committee and the Ethics Committee for Biomedical and Health Research at Adesh University, included patients aged 18 years and above diagnosed with urolithiasis. Inclusion criteria included patients with stone sizes ≥4mm but <20mm, while those with active urinary tract infection, renal failure, severe hydronephrosis, or pregnancy were excluded. A sample size of 170 patients was selected, calculated using the population proportion formula, ensuring 5% margin of error and 50% expected prevalence. Data was collected over six months through a structured, validated questionnaire that gathered socio-demographic details, clinical history, diagnostic findings, and management practices.

The collected data included:

- **Patient Demographics:** Age, gender, level of education, body mass index (BMI).
- **Medical History:** Family history, comorbidities (e.g., hypertension, diabetes), previous episodes of urolithiasis, and any prior surgeries.
- **Clinical Data:** Complaints (e.g., flank pain, hematuria), risk factors (e.g., diet, hydration), and complications associated with urolithiasis.
- **Diagnostic Findings:** Laboratory results (e.g., urine analysis, serum creatinine, calcium levels) and radiological reports (e.g., ultrasound, CT scan).
- **Management Approaches:** Treatment strategies, including medical management (e.g., pain relief, hydration) and surgical interventions (e.g., lithotripsy, ureteroscopy).

Statistical Analysis: To analyse the data, IBM SPSS version 22.0® was used. The subjects' clinical and social background characteristics were compiled using statistical techniques that were descriptive. The Chi-square test for qualitative information was used to examine the relationship between different risk variables and the incidence of urolithiasis. The t test, which is independent, was used to compare group differences for continuous data. Statistical significance was defined as a p-value of less than 0.05.

Results

The present study investigated 170 patients attending the General Surgery Department at Adesh Hospital, Bathinda, to evaluate the prevalence, clinical characteristics, management strategies, and associated risk factors for urolithiasis.

Prevalence of Urolithiasis

A total of 170 cases of urolithiasis were identified from a pool of 1432 patients visiting the General Surgery Department, yielding a prevalence rate of approximately 11.8%. This suggests a moderate occurrence of urolithiasis within the department.

Demographic Characteristics of Patients

- **Age Distribution**

The age group 38-48 years had the highest prevalence of urolithiasis, accounting for 26.5%of the cases. The second most affected group was 28-38 years, comprising 21.2% of cases, followed by 58-68 years (19.4%). This indicates that urolithiasis predominantly affects middle-aged individuals, particularly between 38-48 years.

Tabulation 1: Age Distribution of Study Participants

Age groups (Years)	Frequency	Percentage
18-28 years	24	14.1
28-38 years	36	21.2
38-48 years	45	26.5
48-58 years	14	8.2
58-68 years	33	19.4
68-78 years	14	8.2
78 or above	4	2.4
Total	170	100.0

- **Gender Distribution**

The distribution of urolithiasis by gender revealed that females were more frequently affected (52.4%), compared to males (47.6%), suggesting a higher incidence of urolithiasis in females in this cohort.

Medical History and Comorbidities

- **Pre-existing Conditions:**

Among the 170 patients analyzed, several comorbidities were reported. The most prevalent condition was hypertension (23.5%), followed by diabetes mellitus (9.4%). A combination of hypertension and diabetes was noted in 8.8% of cases. Other conditions included chronic kidney disease (7.6%), asthma (8.2%), and fatty liver disease (6.5%). A total of 5.9% of patients had benign prostatic hyperplasia (BPH), while 2.4% had Hepatitis C virus (HCV) and acute renal failure (ARF). Inflammatory bowel disease (IBD) was reported in 3.5%, and hypothyroidism was seen in 2.9%. Notably, 13.5% of patients had no recorded comorbidities.

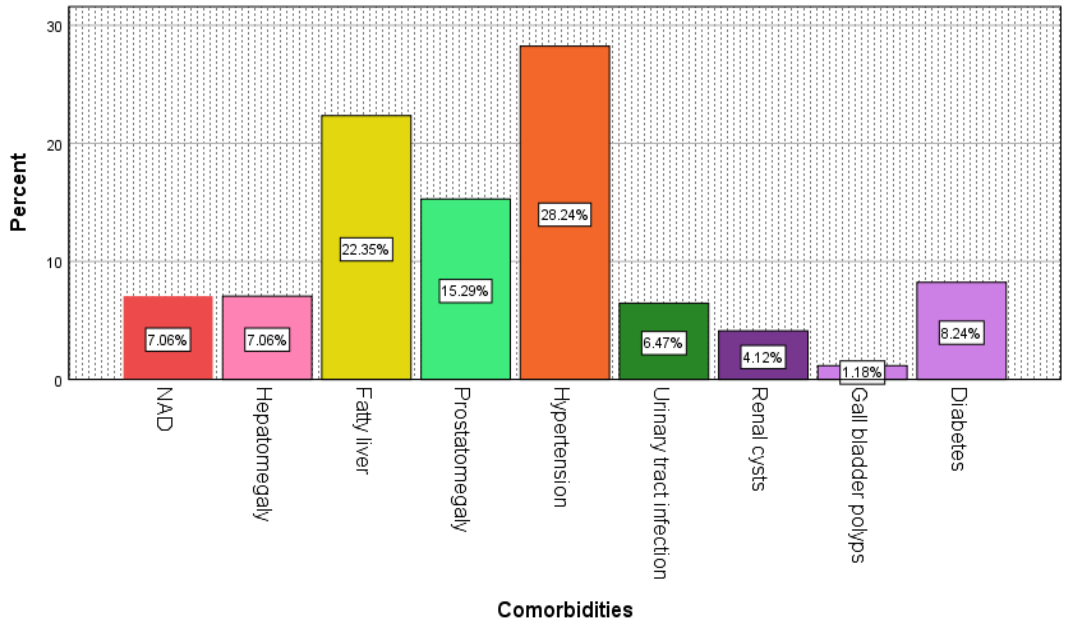

Figure 1: Percentage distribution according to the associated comorbidites

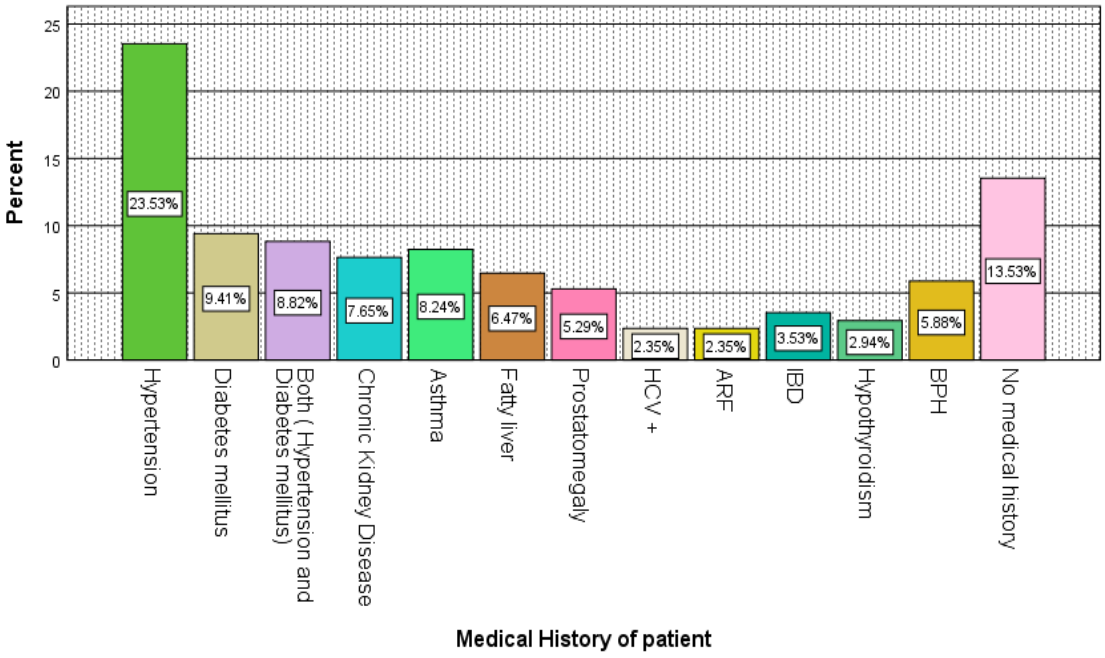

Figure 2: Percentage distribution of patients according to their medical history of patient

Stone Characteristics

➢ **Stone Size Distribution:**

The majority of stones were in the 4-8 mm size range (61.8%), followed by the 8-12 mm size group (27.1%). Larger stones of 12-16 mm and 16-20 mm were observed in 2.9% and 8.2% of cases, respectively.

➢ **Stone Location:**

The most common locations for the stones were the interpole calyx (34.1%), followed by the midpole calyx (20.0%) and lower pole calyx (18.8%). Other locations had a frequency ranging from 1.8% to 8.8%.

Tabulation 2: Distribution according to the size and site of stone

Site of Stone	Size of Stone			
	4-8 mm	8-12mm	12-16 mm	16-20 mm
Interpole calyx	43	10	1	4
Midpole calyx	18	12	2	2
lowerpole calyx	16	13	0	3
Upper ureter	10	3	0	1
Middle ureter	2	2	0	0
lower ureter	14	0	0	1
PUJ	1	4	2	3
UVJ	1	2	0	0

Retained Stones and Surgical Complications

➢ **Retained Stones:**

Approximately **24.7%** of patients had retained stones that required further medical attention, while the majority (**75.3%**) did not experience this issue.

➢ **Surgical Complications:**

Of the 170 patients who underwent surgical procedures, **6.5%** experienced complications, while **93.5%** did not report any post-operative complications.

Treatment Approaches

The treatment modalities employed for managing urolithiasis in the study population were diverse. The majority of patients (55.9%) passed the stones spontaneously. Lithotripsy was the next most common treatment, administered to 22.4% of patients, followed by stent placement (9.4%), ureteroscopy (5.9%), and percutaneous nephrolithotomy (PCNL) (6.5%).

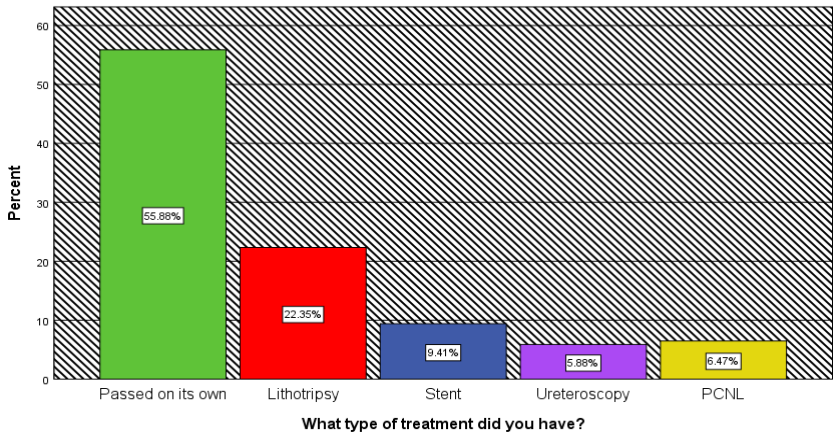

Figure 3: Percentage distribution according to the type of treatment given.

Stone Composition

- **Types of Stones:**

  The most common type of stone was calcium-based stones, which accounted for 77.1% of cases. Struvite stones were the second most common, comprising 19.4%, while uric acid stones were observed in 2.9% of cases. Cystine stones represented the least common type, making up only 0.6%.

Tabulation 3:- Distribution according to the kind of stone

Type of stone	Frequency	Percent
Calcium stones	131	77.1
Struvite stones	33	19.4
Uric acid stone	5	2.9
Cystine stone	1	.6
Total	170	100.0

RISK FACTORS:-

The study investigated various factors influencing urolithiasis in 170 individuals and identified significant associations with lifestyle, dietary, and medical variables. Inadequate water intake (<2-3 liters/day) was linked to a higher incidence of stones, with a greater number of cases among those consuming less water. Similarly, individuals with a BMI between 25 and 39.99, higher sodium intake, and excessive daily sweating were more likely to experience stone formation. Medical conditions like hypertension and diabetes also showed a positive correlation with stone occurrence, as did frequent NSAID use. Behavioral factors, including smoking and alcohol consumption, were linked to a higher chance of developing stones. The above results demonstrate the importance of addressing modifiable risk factors such as maintaining adequate hydration, managing BMI, reducing sodium intake, and avoiding smoking and alcohol consumption to reduce the prevalence of urolithiasis and improve overall health outcomes.

Quality of Life

The analysis of paired differences in quality of life before and after treatment for kidney stones revealed significant improvements in various domains. Patients reported a marked reduction in time off work due to health conditions ($p < 0.001$) and experienced decreased difficulty in sleeping ($p < 0.001$). There was a significant enhancement in their ability to cope with daily issues ($p < 0.05$) and a reduced impact of dietary or fluid restrictions on their daily lives ($p < 0.001$). Furthermore, the influence of kidney stones on work performance showed a positive change These findings underscore the effectiveness of kidney stone treatment in improving several critical aspects of patients' quality of life, although certain areas, such as social mobility, remained unaffected.

Tabulation 4:- Progress of management with respect to Quality of Life

Paired Differences								
Quality of Life	**Mean**	**Std. Deviation**	**Std. Error mean**	**95% Confidence Interval of the Difference**		**t**	**df**	**Sig**
				Lower	**Upper**			
Lost time off work (Before treatment) - lost time off work (After treatment)	.08824	.2844	.0218	.13131	.0451	4.04	170	.000
Difficulty in sleeping? (Before treatment) - Difficulty in sleeping? (After treatment)	1.1823	1.0127	.0776	1.0290	1.335	15.2	170	.000
Effect on your work (Before treatment) - Effect on your work (After treatment)	1.1764	1.0566	.0810	1.0164	1.336	14.5	170	.000
Reduced ability to cope	.176	.8861	.0679	.04230	.3106	2.59	170	.000

with daily issues (Before treatment) - Reduced ability to cope with daily issues (After treatment)								
Dietary or fluid changes affected your daily life? (Before treatment)- Dietary or fluid changes affected your daily life? (After treatment)	1.005	1.063	.0815	.8449	1.166	12.3	170	.000
Reduced freedom to travel (Before treatment) - Reduced freedom to travel (After treatment	.0058	.5273	.0404	.0739	.0857	1.45	170	.885

Management

The provided data outlines the distribution of treatment options among a sample of 170 patients across various medication categories. For antibiotics, Levofloxacin accounted for 41.8% of prescriptions, followed by Cefexime with Potassium clavulanate at 32.9%. Notably, 10.0% of patients were not prescribed antibiotics, and smaller percentages received Amikacin (2.9%), Faropenem and Potassium clavulanate (4.1%), or Ciprofloxacin (8.2%).Moving to proton pump inhibitors, Pantoprazole constituted 35.3% of the prescriptions, while a majority (64.1%) were prescribed Rabeprazole with Domperidone. Only a small percentage (0.6%) were not prescribed any proton pump inhibitors. For anticholinergics, a significant portion (66.5%) were not prescribed this class of medication, while Tolterodine tartrate represented 32.9% of the prescriptions. Bethanechol chloride was prescribed to a single patient (0.6%).Concerning antiemetics, the majority of patients (80.6%) were not prescribed these medications. Among those who were, Ondansetron constituted 19.4% of the prescriptions. Similar trends were observed for NSAIDs, with 60.6% not being prescribed any NSAIDs, while Paracetamol (37.1%) and

Paracetamol with caffeine (2.4%) were the prescribed options. In the antispasmodic category, a significant proportion (65.3%) were not prescribed these medications. Among those prescribed antispasmodics, Aclofenac and Drotaverine accounted for 30.0% of the prescriptions, followed by Solifenacin at 4.7%. For urinary alkalinizers, the majority of patients (98.2%) were prescribed Potassium citrate and citric acid, while only a small proportion (1.8%) were not prescribed any urinary alkalinizers.Lastly, in the alphablockers category, 30.0% of patients were not prescribed any, while Tamsulosin constituted the largest portion of prescriptions at 40.0%. Silodosin (27.1%) and Alfuzosin (2.9%) were also prescribed to some patients.These findings reflect the diverse treatment preferences and choices across various medication categories for the studied patients, offering insights into the therapeutic approaches adopted for managing their conditions.

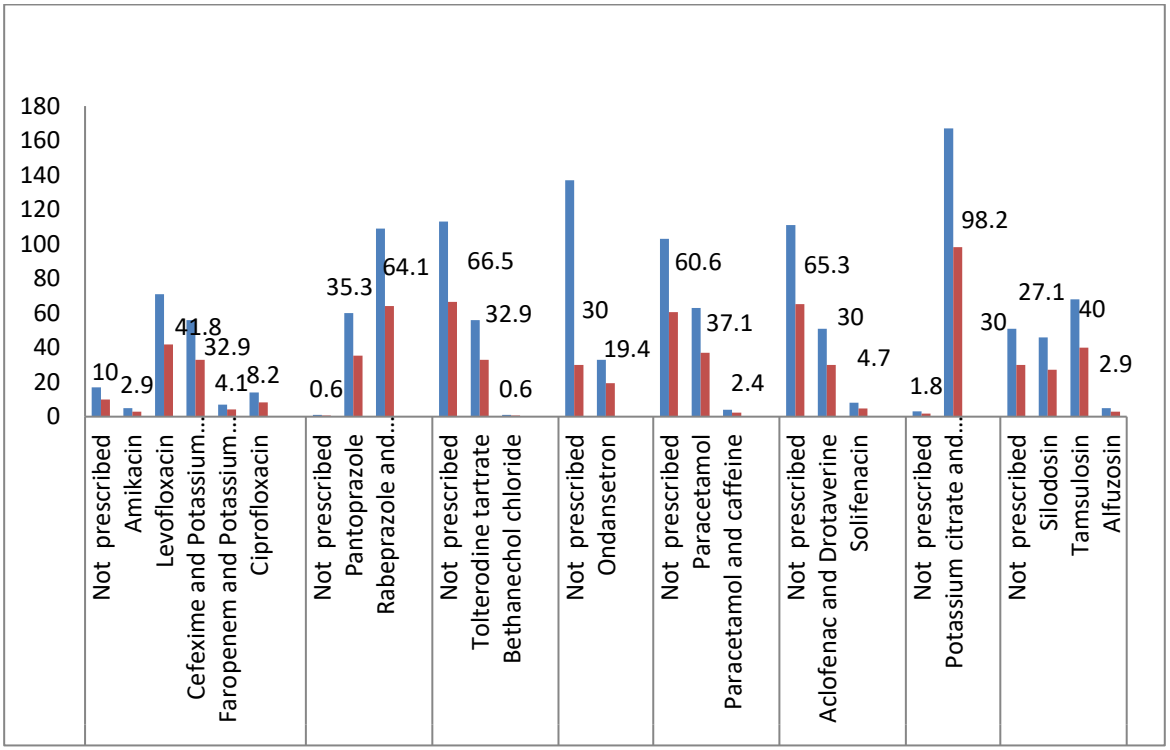

Figure 4:- Percentage distribution of Patients according to the treatment given

DISCUSSION:-

The study's findings are in close agreement with the body of previous literature on urolithiasis. while offering unique insights into the local population. The observed prevalence of 11.8% among the study population is consistent with global estimates of 5–15% reported in research conducted by ***Pak et al.*** and ***Coe et al.,*** emphasizing the significant burden of this condition. Regional studies, such as those by *Türk et al.*, also highlight similar prevalence rates, underscoring the universality of urolithiasis as a public health concern. This prevalence reinforces the need for targeted interventions and improved healthcare strategies to manage this condition effectively.

The age distribution in this study, which identified the highest prevalence among individuals aged 38–48 years, supports findings from ***Stamatelou et al***. and ***Ljunghall et al.*** These investigations verify howmiddle-aged adults are particularly vulnerable to stone formation due to physiological changes, metabolic factors, and dietary habits. Gender differences observed in this study, with a higher prevalence

in females, align with research suggesting that hormonal influences, such as estrogen's role in calcium metabolism, may contribute to stone formation. Anatomical factors and lifestyle choices, including dietary patterns, may further explain these differences, as highlighted in research conducted by ***Taylor et al.*** and ***Curhan et al.***

Stone size as well as localization patterns observedare in line with the larger body of research in this investigation.The majority of stones were between 4–8 mm, with the interpole calyx becoming the most popular location. ***Pearle et al.*** have observed comparable results, who identified the lower pole calyx as another frequent site for stone formation due to urine stasis and gravity. Understanding these patterns is critical for guiding innovative methods like PCNL or ESWL as emphasized in ***Türk et al.*** guidelines on urolithiasis management.

The strong association between urolithiasis and comorbidities such as hypertension, diabetes, and obesity observed in this study corroborates findings by ***Roudakova et al.,*** who described metabolic syndrome as a significant risk factor for stone formation. Hypertension, in particular, has been linked to altered renal calcium handling and increased urinary calcium excretion, which predisposes individuals to stone formation. Similarly, diabetes is associated with changes in urinary pH and increased risk of uric acid stones, as reported in ***Siener et al.'s*** work.

Lifestyle-related risk factors identified in this study, including high sodium intake, alcohol consumption, smoking, and frequent NSAID use, have been extensively documented in prior research. For example, ***Curhan et al.*** demonstrated that excessive sodium intake increases calcium excretion in urine, raising the likelihood of calcium stone formation. Alcohol and smoking have also been implicated as indirect contributors to urolithiasis through their effects on hydration status, renal function, and oxidative stress. Frequent NSAID use, although often for pain relief in chronic conditions, may contribute to renal dysfunction and stone formation, as noted by ***Bensalah et al.***

The predominance of calcium oxalate stones in this study reflects global trends reported in studies by ***Taylor et al.*** and ***Pearle et al.,*** which highlight calcium-based stones as the most common type. This underscores the importance of dietary interventions, such as reducing oxalate-rich foods and maintaining adequate calcium intake, to prevent recurrence. The diversity in stone composition observed further supports the need for individualized treatment approaches tailored to specific metabolic abnormalities.

The study's findings hold critical clinical and public health implications. From a clinical perspective, the insights into stone composition, localization, and associated risk factors provide a foundation for developing personalized treatment strategies. Urologists can use this information to guide decisions regarding medical management, surgical intervention, or lifestyle modifications. For instance, patients with calcium oxalate stones may benefit from dietary counseling to reduce oxalate intake and improve hydration, as suggested by ***Curhan et al.***

Public health strategies can be informed by the identification of modifiable risk factors such as high sodium intake, obesity, and smoking. Similar interventions in other regions, as highlighted by ***Siener et al.,*** have successfully reduced stone recurrence rates through community-based education and lifestyle

counseling. These findings emphasize the need for healthcare systems to invest in awareness campaigns and preventive measures targeting high-risk populations.

This research provides a comprehensive analysis of urolithiasis, incorporating demographic, clinical, and lifestyle factors. The detailed evaluation of stone composition and localization adds valuable data that can guide clinical decision-making and improve treatment outcomes. Additionally, the investigation emphasises the significant role of comorbidities as well as lifestyle factors, offering actionable insights for prevention and management.

The study does have several drawbacks, though. Its single-center setup and retroactive approach might restrict how far the results can be applied. Given relatively small sample size restricts the statistical power of subgroup analyses, potentially obscuring smaller associations or differences. Recall prejudice may occur when personal characteristics are based solely on patient-reported data, which could affect the accuracy of risk factor analysis.

Future research should concentrate on a number of important areas in order to build on the conclusions of this study. For the purpose of evaluating the cumulative effectiveness of diets, lifestyle, and pharmacological interventions in preventing stone recurrence. Comparative studies between surgical and non-surgical management approaches across diverse healthcare settings can further refine treatment protocols and optimize patient outcomes.

Advances in molecular and genetic research, as suggested by ***Shavit et al.,*** could lead to the identification of genetic markers associated with stone formation, enabling targeted prevention strategies for high-risk individuals. Additionally, public health initiatives should focus on increasing awareness about the role of hydration, dietary modifications, and the impact of comorbidities on urolithiasis risk.

Further exploration into the environmental and occupational factors contributing to urolithiasis, particularly in regions with high prevalence rates, could provide additional insights into prevention strategies.By emphasizing the role of lifestyle modifications, dietary interventions, and personalized treatment approaches, this research underscores the importance of a holistic strategy in addressing urolithiasis. Future research should build on these findings to further explore the complexities of this condition and refine treatment and prevention strategies for diverse populations.

CONCLUSION:-

The research presented here offers important new information about the risk factors, management strategies, and epidemiology of urolithiasis. 11.8% of the participants in the research had urolithiasis, with thehighest occurrence in middle-aged individuals aged 38–48 years and a higher prevalence in females. Significant risk factors identified include high sodium intake, overweight status, alcohol consumption, smoking, and frequent NSAID use. Comorbidities such as hypertension and diabetes were also strongly associated with stone formation, emphasizing the interplay between metabolic health and urolithiasis.Management practices predominantly involved outpatient care, with surgical intervention required in only a small proportion of cases, reflecting advancements in minimally invasive procedures. Stone composition analysis revealed a predominance of calcium-based stones, which necessitates tailored dietary and medical interventions to prevent recurrence.For healthcare providers, the findings

underscore the importance of a comprehensive approach to managing urolithiasis. This includes identifying and addressing modifiable lifestyle factors, providing patient education on hydration and dietary modifications, and ensuring regular follow-ups for individuals with metabolic comorbidities. Public health initiatives focused on prevention and early detection can further reduce the burden of this condition.In summary, the study highlights the need for personalized treatment strategies and a holistic management approach to improve patient outcomes and reduce the recurrence of urolithiasis.

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