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A Comprehensive Analysis of Evaluating Pain Assessment, Prevalence, Risk Factors for Renal/Ureteric Calculi Patients Presenting to an Emergency Department

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ABSTRACT

Kidney stone disease is a prevalent urological condition affecting both children and adults. This study aims to evaluate pain assessment, prevalence, and associated risk factors in renal/ureteric calculi patients presenting to the emergency department. A Cross sectional studies was conducted in the Department of Emergency Medicine (ED)at Sri Ramachandra Institute of Higher Education and Research, Porur, Chennai over a period from January 2023 to December 2023, involving 312 patients. The study participants were predominantly males, with an average age ranging from 21 to 30 years. Among the identified risk factors, 48% of participants reported consuming 2–3 liters of water daily, while 74% had a family history of calculi. Additionally, 40% of participants had diabetes, and 78% consumed excessive amounts of salt. The most common type of calculi observed among participants was left ureteric calculi. Based on correlation analysis, the data indicated no significant correlation between the size of the calculi and the pain score. This study highlights the importance of preventing renal calculi by evaluating their prevalence and associated risk factors. Additionally, it examines the association between the severity of pain and the size of the calculi, while also identifying the different types of renal calculi. **Conclusion:** The findings suggest that lifestyle and Heriditary factors play an important role in the development of Renal/Ureteric calculi. While the intensity of pain does not correlate with the size of calculi. Risk factor modification such as dietary control and hydration may aid in reducing the burden of Kidney stone disease in the community.

Keywords: Kidney Stones, Risk Factors, Pain Assessment, Emergency, Prevalence.

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ABBREVIATIONS

VAS: Visual Analogue Scale; ED: Emergency Department; CT: Computed Tomography; USG: Ultrasonography; SWL: Shockwave Lithotripsy, URS: Ureteroscopy; PCNL: Percutaneous Nephrolithotomy.

INTRODUCTION

Kidney stone disease is commonly seen in general practise in both children and adults. The development of human kidney stones affects a vast number of people worldwide inspecific age-groups. In India, it is expected that 12% of the population will have urinary stones. Recurrent stone formation is a common problem for all forms of stones and is therefore an important part of medicine. The incidence of urolithiasis varies in different countries [1]. Kidney stones are formed when minerals such as calcium, oxalate, uric acid become supersaturated in the urine and form crystal. These crystals can aggregate to form stones, which may pass into ureter. When dislodged in the ureter, the stone obstructs the urine flow causing increased intra luminal pressure, spasm and distension of ureter [2]. In India, the "stone belt" occupies parts of Maharashtra, Gujarat, Rajasthan, Punjab, Haryana, Delhi, and the states of the northeast. Fewer occurrences of urinary calculi were found in southern India [1]. The development of kidney stones caused by dietary habits (diet), age, sex, obesity, genetics, environmental factors, geographic location, climate, and lifestyle. The prevalence of this disease has increased among males and females of all ages, suggesting not only genetic predisposition but also a potential environmental cause. The incidence of stone disease is also rising globally with Calcium oxalate and/or phosphate stones account for almost 70% of all renal stones observed in economically developed countries [3]. Localization and quality of pain are associated with the placement of the stone inside the urinary tract. Pain associated with renal/ureteric calculi is often severe and is one of the most common reasons for emergency department (ED) visits related to urological disorders [4]. The severity of pain is related to the degree of obstruction, the presence of ureteral spasm, and the presence of any associated infection. Stones obstructing the ureteropelvic junction may present with Mild-to-excessive deep flank ache without radiation to the groin because of distention of the renal capsule. Stones impacted within the ureter cause abrupt, severe, colicky pain in the flank and ipsilateral lower abdomen with radiation to the testicles or the vulvar area. Despite advancements in imaging and treatment modalities, a standardized approach to pain assessment and management in emergency settings remains a challenge [5]. The objective of this study is to evaluate the prevalence of renal calculi and ureteral calculi among patients visiting the emergency department of Sri Ramachandra Institute of Higher Education and Research Institute and to assess the factors influencing the development of kidney stones and also to find out the independent relationship of the following risk factors, especially family history, past history, insufficient fluid intake, dietary habits, urine output and association with lifestyle modifications. This study also looked into the interpretation of pain scores in renal/ureteric Calculi patients who presented to an emergency department.

MATERIALS AND METHODS

The study was conducted at the Department of Emergency Medicine, Sri Ramachandra Institute of Higher Education and Research, Porur, Chennai. This study was carried out over a period from January 2023 to December 2023. It included a cross sectional Analysis of 312 Patient record admitted for Urological emergencies in casualty during this period. This study includes participants with Urosepsis, Hydroureteronephrosis, Impaired Renal Function, Persistent Symptoms, Calculi >1.5mm Size, this study Excludes CT for pregnant woman, Paediatrics, adolescent < 18yrs. patients diagnosed with renal/ureteric calculi were selected by a purposive sampling technique. Risk factors were assessed by using an open-ended questionnaire and a self- administered questionnaire, which includes the recurrence of stone formation; family history; and water intake; Urine output; dietary habits; lifestyle modifications associated with other diseases (Hypertension, Diabetes, and UTI). The Radiographic investigation includes USG abdomen for initial screening, Non-Contrast Computer Tomography(NCCT) of (KUB), X-ray (KUB), when CT is contraindicated. The data was analysed by means inferential statistics such as Chi-square test and Correlation Analysis were applied to identify association between variables such as stone size and pain scores. A p - value < 0.05 was considered statistically significant. Also analyze the pain score by using visual and verbal analogue scales(VAS).

RESULTS

Over a 12 Month Period, 312 Patients were managed in Urological emergencies. The monthly Incidence was 26 cases. Male Patients Were Predominantly represented (n=203) with

a male to female ratio of 1.86. The average age of Patients 21-30 Years. The most represented age group was 21-30 Years accounting for 66% of the total Participants. All patients were admitted through emergency department with the majority belonging to a lower middle economic status. Most patients reported a daily water consumption of water 2-3L/day. A family History of Renal calculi was present in 74%of the cases. 37% of Patients had Diabetic Melllitus, While 78% reported excessive salt consumption. Furthermore 74% of patients worked under Prolonged Sun Exposure, and 60% consumed milk and milk products twice daily.

Table 1. Demographic Data for patients with Renal calculi

S.NO	Age (yrs.)	Percentage
	11-20	0.926
	21-30	32.407
	31-40	28.704
1	41-50	21.296
	51-60	10.185
	61-70	5.55
	71-80	0.926
	Gender	
2	Male	65
	Female	34
	Socio Economic status	0.926
	Upper	
3	Upper middle	0.926
	Upper lower	8.33
	Lower middle	48.15
	Lower	41.7
	Education	64
	Illiterate	
	literate	93
	Occupation	11.11
	Clerk/shop owner/Farmer	
	Skilled Work	31.48
	Semi-Skilled Work	22.2
	Unskilled Work	19.4
	Unemployed	15.74
	Marital status	
	Married	87
	Unmarried	12

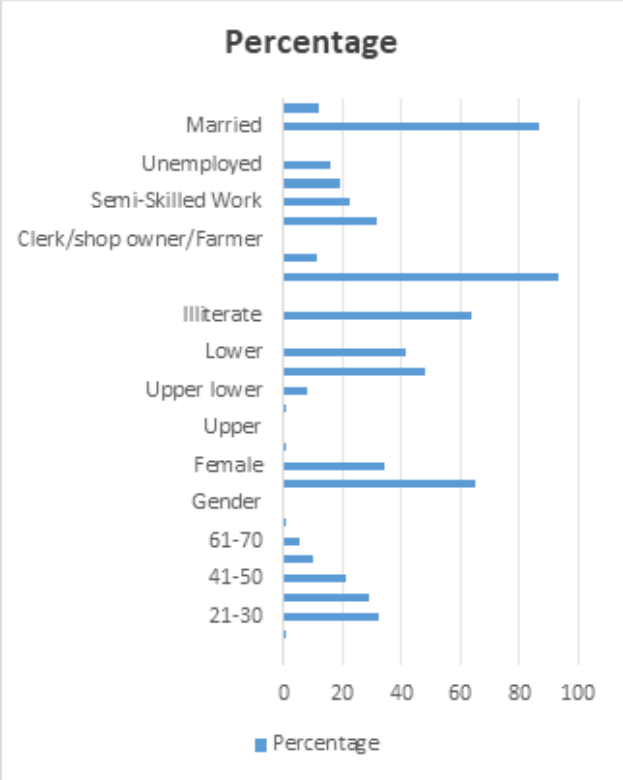

Figure 1. Distribution of Demographic data for patients with Renal calculi.

Table 2. Risk factors Responsible for Renal Calculi

RISK FACTORS	PERCENTAGE (%)
Water Intake -2-3 L	44.44
Water Intake - 3 L	39.81
More than 3L	15.74
Family history	74.074
Diabetic Mellitus	37.04
Hypertension	27.78
Both HTN,DM	28.7
None	6.48
Consumption of excessive amount of salt	78.7
Past History calculi	81.48148148
Hot weather	74.074
Agriculture	20.37
Coolie	5.556
Alcohol -once weekly	55.56
Alcohol -twice weekly	14.81
Alcohol -once monthly	9.26
No Alcohol	20.37
Meat -Once weekly	23.1481
Meat -twice weekly	64.8148
Meat -once monthly	9.2593
Rarely - Meat	2.7778
Urine output -5-8 times	13.889
Urine Output -3-5 times	70.37
Urine output -below 3 times	15.741
UTI	74.07
Milk and milk products -once daily	39.8
Milk products, Milk -twice daily	60.2

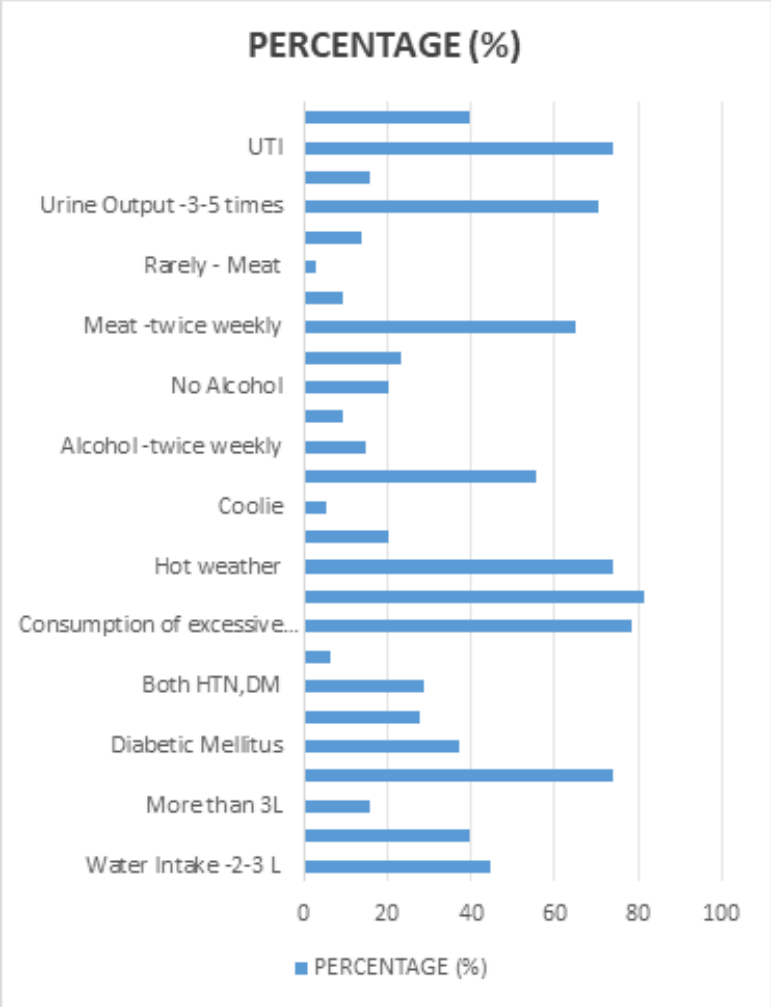

Figure 2. Risk factors Responsible for Renal Calculi.

Table 3. Types of Calculi

Types of Calculi	Percentage
Right Renal Calculi	17.59
Left Renal Calculi	19.44
Right Ureteric Calculi	24.07
Left Ureteric Calculi	25.93
Bilateral Renal	9.26
Bilateral Ureteric	3.70

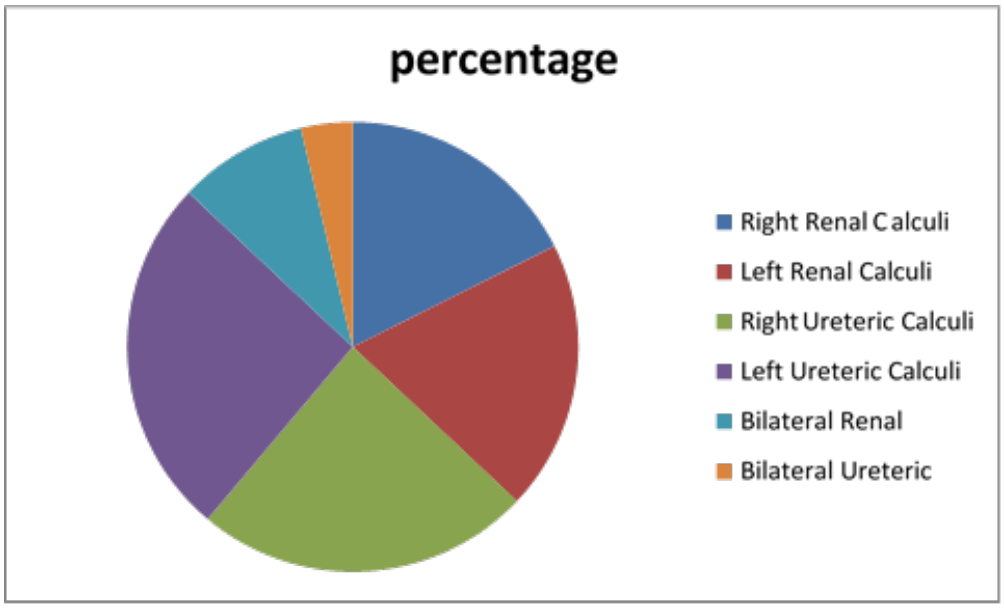

Figure 3. Types of Calculi.

Pain score and size of calculi

X axis = size of calculi Y axis = Pain score

In this study there is no correlation between size of calculi and Pain score.

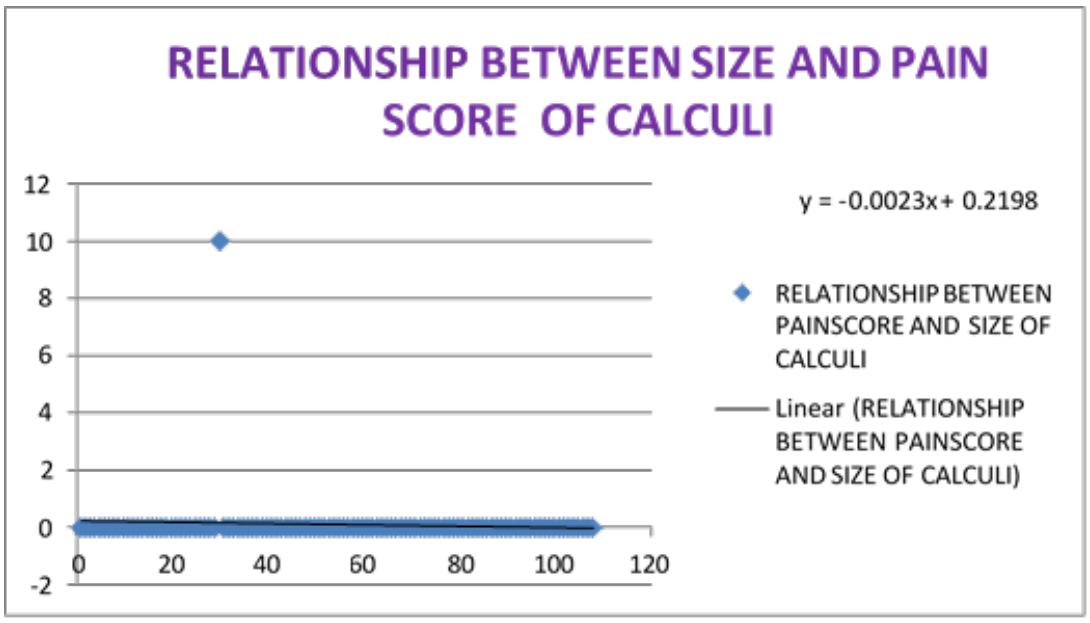

Figure 4. Relationship Between size and pain score of calculi.

DISCUSSION

This study highlights the significance of renal and ureteric calculi as a prevalent urological emergency, particularly among young adults. With a total sample collected over a year (January 2023 to December 2023), our findings echo those in the existing literature, wherein kidney stone disease disproportionately affects males in the age group of 21–30 years. A male predominance in stone presentation is consistent with earlier studies [1,3], suggesting a potential hormonal or lifestyle-related predisposition in this demographic.

In our study, the most commonly encountered calculi were left ureteric stones, aligning with previous literature that

shows the ureter as a frequent site for stone impaction due to its narrow diameter and high peristaltic activity. However, contrary to some prior studies where bilateral renal stones were more prevalent [4], our data found unilateral ureteric calculi to be dominant.

Statistical Analysis using chi-square and correlation tests were applied to analyze the associations between demographic, lifestyle, and clinical variables. The p value for age was 1.086(>0.05), indicating no significant association between age and calculi formation, whereas gender had a p value of 0.001(<0.05), showing a significant association with stone occurrence. Socioeconomic status was also found to be significantly associated (p=0.04<0.05), which may reflect dietary habits, hydration status and health care [5]

Variables such as educational level (p=1.82) and marital status (p=1.34), showed no statistical association which is (>0.05), while occupation status shows a significant relationship (p=0.03<0.05), possibly due to dehydration in outdoor workers. Pain score (VAS) had a p value of 0.97 indicating no association with stone size [6].

An important observation was that pain severity (measured by the Visual Analogue Scale) did not significantly correlate with the size of the calculi, which is in agreement with recent findings emphasizing that pain is influenced more by location, degree of obstruction, ureteral spasm, and presence of infection rather than stone size alone [5]. Stones lodged at the ureteropelvic or ureterovesical junctions typically present with severe flank or lower abdominal pain radiating to the groin or genitalia, which is characteristic of colicky ureteric pain.

Our study also revealed various risk factors which include family history (74%), excessive salt Intake (78%), diabetic mellitus (40%), and low to moderate water consumption (52%). These findings are consistent with previous research findings indicating a complex etiology involving nutritional, metabolic, genetic components [6]. The correlation between daily water intake and stone formation was statistically significant (p=0.04). Notably [7,8], the significant number of people with a family history of renal calculi emphasizes the genetic character of urolithiasis and lends credence to the concept that familial clustering is a major predictor [7].

While 48% of patients reported consuming 2-3 liters of water per day, this alone is not adequate for avoiding stone formation, indicating that quality of hydration, urine concentration, and fluid intake may be as important as the amount, these are also the factors need to be considered. Furthermore, dietary salts have been shown to enhance urine calcium excretion, which might have a higher prevalence of stones among those with excessive salt consumption [8].

Urine output (p=0.078>0.05) did not show a significant association; however, UTI presence had a p value of 0.049, showing that infection may contribute to the result of stone disease. Milk and dairy product consumption (p=0.002) also shows a strong association, supporting theories about calcium oxalate crystallization [9].

Alcohol consumption twice weekly (p=0.002) and meat consumption twice weekly (p=0.004) were also significantly associated with stone formation, these dietary elements may increase purine metabolism and or increase urinary calcium level, predisposing to calculi formation [10,11].

The recurrence of renal calculi is influenced by several factors, including stone composition, metabolic abnormalities and life style factors, Highlighted the dietary habits such as high intake of salt and low fluid composition, are significant contributors to stone recurrence [13]. The recurrence of renal calculi also impacted by the size, location of stones or those located in the lower ureter tend to be more likely to cause repeated episodes [11]. Management strategies to prevent recurrence involve addressing underlying metabolic abnormalities such as hypercalciuria and hyperoxaluria, as critical contributors to recurrent stone formation [12].

The Medical management of renal stone disease begins with conservative measures, such as fluid intake, dietary adjustments and pharmacological interventions to alleviate pain and facilitate stone passage [3]. Medical Expulsive therapy (MET) using alpha blockers like tamsulosin has been widely recognized in managing ureteric stones. MET can enhance stone passage in patients with stone size (<10mm), particularly those located in the distal ureter [4]. However, for large stones or those causing significant obstruction medical management alone is often insufficient, and surgical options is required [5].

Surgical Intervention is necessary for patients with large, obstructive or recurrent stones. Several techniques are available, which includes shockwave lithotripsy (SWL), ureteroscopy (URS), percutaneous nephrolithotomy (PCNL).

SWL, which utilizes shockwaves to fragment stones, is effective for most stones <2cm and is associated with minimal invasiveness [2], However, for stones > 2cm or stones located in renal pelvis, PCNL is considered the gold standard, as it enables complete stone removal [7]. Ureteroscopy is often employed for stones located in the distal ureter or near the bladder [6]. For recurrent or bilateral stones, or in case of any conservative measures fails, the combination of SWL and URS may provide an effective treatement regimen [5].

In terms of management, individuals with renal/ureteric colic requires immediate and precise pain evaluation to ensure appropriate triage and management. However, as our study evaluates there is no standardized strategy for pain analysis. This represents an ongoing issue in emergency care and emphasizes the necessity for standardized pain assessment instruments need to be designed specifically for urological crises [9].

This study also supports the importance of the early identification of risk factors and the lifestyle modification is critical in preventing recurrence, which is frequent in urolithiasis. Encouraging dietary adjustments [10], increasing fluid intake [11], moderating salt consumption [12], and screening individuals with a family history [13] could significantly reduce the disease burden.

Our study's limitations include a single-center setting and inadequate follow-up on recurrence rates, Furthermore, stone composition analysis was not routinely undertaken [2]. Finally, this study offers a detailed assessment of risk profiles, and pain scores, of individuals with renal and ureteric calculi in an emergency department. The findings emphasize the necessity of risk assessment and pain evaluation techniques, as well as public education about preventive measures [14,15].

CONCLUSION

This study establishes renal and ureteric calculi as significant urological emergencies, predominantly affecting young adult males, with the 21-30 age group showing high incidence. The prevalence of unilateral ureteric stones and male predominance aligns with existing literature.

Statistical analysis revealed strong associations between stone formation and modifiable risk factors such as low water intake, high salt consumption and meat consumption, alcohol use twice weekly, family history, UTI presence, and occupational exposure to heat. Notably, no significant correlation was found between stone size and pain severity, as the pain is influenced more by location and complications than by stone size. These findings provide valuable evidence supporting the need for early lifestyle modifications, dietary guidance, and public education to mitigate recurrence. The study highlights the integration of preventive strategies into emergency care protocols to reduce the burden of urolithiasis.

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CONFLICTS OF INTEREST

The authors declare there is no conflict of interest.

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