PREVALENCE OF RENAL CALCULI IN ADULTS WITH ACUTE RENAL COLIC IN A TERTIARY CARE HOSPITAL DISTRICT PESHAWAR USING ULTRASOUND

Original Research

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ABSTRACT

Background: Renal colic, often caused by renal calculi, is one of the most common urological emergencies and significantly affects adult populations worldwide. Its development is influenced by several interrelated factors, including hydration status, dietary patterns, genetic predisposition, and existing comorbidities. In regions with variable healthcare accessibility, such as parts of South Asia, identifying modifiable risk factors is crucial to reducing the incidence and burden of this condition.

Objective: To assess the prevalence of renal calculi in adults presenting with acute renal colic and to examine associated demographic, dietary, and lifestyle risk factors using ultrasound as a diagnostic tool.

Methods: A descriptive cross-sectional study was conducted at the Radiology Departments of RMI Teaching Hospital and Alkhidmat Blood Bank and Diagnostic Center, Peshawar, between July and October 2024. A total of 196 adults aged 18 to 60 years with acute renal colic symptoms underwent ultrasound evaluation. Participants were selected using a stratified sampling method and assessed via a semi-structured questionnaire addressing demographics, lifestyle, diet, family history, and comorbidities. Data were analyzed using SPSS version 25. Chi-square tests and logistic regression were employed to identify significant associations and predictors.

Results: Renal calculi were diagnosed in 17% of participants. The highest prevalence was seen in the 31–40 years age group (35.7%), with males comprising 61.2% of cases. Urban residents represented 55.1%. Significant associations were observed between renal colic and low water intake (<4 glasses/day; $p < 0.001$), high intake of salty/sugary foods (58.2%; $p < 0.001$), oxalate-rich foods (40.8%; $p = 0.001$), and low calcium intake (57.1%; $p < 0.001$). Comorbidities such as obesity (24.5%), hypertension (21.4%), gout (12.2%), and diabetes (9.7%) were also significantly associated ($p = 0.016$).

Conclusion: The study underscores the strong link between renal colic and modifiable factors such as hydration and diet. Preventive strategies focusing on increased water intake and balanced nutrition are essential to reducing the risk of renal calculi in adult populations.

Keywords: Diabetes Mellitus, Dietary Habits, Hypertension, Obesity, Renal Calculi, Renal Colic, Ultrasonography.

INTRODUCTION

Renal calculi, commonly known as kidney stones, have been a recognized medical condition for thousands of years, with their presence documented as early as 4000 years ago in ancient Egyptian texts such as the Ebers Papyrus and in the classical writings of Hippocrates and Galen (1). These early records laid the groundwork for the modern understanding of nephrolithiasis, a condition that has since been associated with various metabolic, genetic, and environmental factors. Recent advancements in medical research have deepened insights into the etiology of stone formation, highlighting contributory roles of hyperparathyroidism, cystinuria, urinary tract infections, and certain dietary and lifestyle habits (2). The global rise in the incidence of kidney stones has drawn significant attention to the interplay between contemporary dietary patterns—particularly high intake of salt, animal protein, and oxalates—and comorbidities such as obesity, diabetes, and hypertension (3). Clinically, renal stones typically remain asymptomatic until they migrate into the ureter, where they often provoke intense pain known as ureteric colic. This acute presentation necessitates prompt diagnosis and management, ranging from conservative approaches to more invasive surgical interventions, guided by the stone's size, location, and the patient's clinical profile (4). Historically, intravenous urography (IVU) served as the gold standard for diagnosis; however, technological progress has shifted preference toward ultrasound (USG) due to its non-invasiveness, broad accessibility, and absence of ionizing radiation (5). Despite its advantages, ultrasound can occasionally miss stones masked by surrounding anatomical structures, indicating the need for judicious diagnostic selection (6).

The prevalence of nephrolithiasis shows marked variation across age, sex, and geographic regions. Men face a higher lifetime risk—estimated at 12% compared to 6% in women—with the peak incidence occurring between the ages of 40 and 60. Environmental conditions also play a notable role, with warmer climates and seasonal variations linked to increased stone formation due to factors such as dehydration and altered urinary composition (7). Epidemiological data from countries like Japan show a threefold increase in incidence over recent decades, reflecting broader global trends in rising urolithiasis rates (8). Ureterolithiasis, in particular, stands out as one of the most common urological emergencies worldwide, disproportionately affecting men in their productive years. In developing regions, the burden of urinary stone disease continues to grow, compounded by limited healthcare infrastructure, poor awareness, and increased exposure to modifiable risk factors including smoking, alcohol consumption, and sedentary lifestyles (9). Recurrence rates remain high, particularly in those with metabolic predispositions or inadequate preventive strategies, making recurrent nephrolithiasis a persistent challenge in clinical nephrology (10). The distal ureter emerges as the most frequent site of stone impaction, often leading to obstructive uropathy and renal compromise if not managed appropriately.

Despite the extensive body of literature on nephrolithiasis, gaps remain in understanding its evolving epidemiological patterns, especially in specific population subsets and geographic zones. While numerous studies have examined stone composition and recurrence risk, fewer have addressed the role of environmental and lifestyle variables in stone development within varied demographic contexts. The objective of this study is to assess the prevalence, clinical presentation, and associated risk factors of ureteric calculi within a defined population, aiming to contribute meaningful insights that support early detection, targeted prevention, and optimal management strategies (11).

METHODS

This cross-sectional study was conducted over a four-month period, from July to October 2024, with the objective of assessing the clinical and epidemiological profile of patients presenting with renal calculi. A total of 196 participants were recruited from RMI Teaching Hospital and AlKhidmat Hospital in Peshawar. Ethical approval was obtained from the Clinical Research Ethics Committee of the Pakistan Institute of Medical and Management Sciences, as well as from the institutional review boards of the participating hospitals. Written informed consent was obtained from all participants, with assurance of voluntary participation and confidentiality in accordance with ethical research practices. Participants included individuals aged 18 to 60 years presenting with acute renal colic or urinary retention suggestive of renal or ureteric stones. Exclusion criteria comprised individuals with severe systemic illnesses, post-operative conditions, pregnancy, or those residing outside the catchment area, ensuring a homogenous sample relevant to the study objectives (3,4). A stratified sampling approach was adopted to enhance representativeness across age and gender groups. Data collection was facilitated through a structured and pre-tested questionnaire administered via face-to-face interviews by trained medical personnel. The questionnaire encompassed five domains: demographic details, clinical symptoms, diagnostic findings, lifestyle and dietary habits, and personal and family medical history.

Ultrasound examinations were conducted using standardized imaging protocols with calibrated equipment across both institutions. To ensure diagnostic consistency, scans were performed by experienced radiologists, and inter-observer reliability was maintained through periodic cross-verification of a random subset of cases. Data regarding lifestyle and dietary habits were gathered using validated and culturally adapted instruments to reduce recall bias and enhance reliability. All data were entered and analyzed using IBM SPSS Statistics

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version 25. Descriptive statistics, including means, frequencies, and percentages, were employed to describe the demographic and clinical characteristics of the participants. Associations between categorical variables were assessed using the chi-square test, and logistic regression analysis was performed to identify significant predictors of renal calculi, adjusting for potential confounders. The analysis aimed to determine the influence of modifiable and non-modifiable risk factors on stone formation and recurrence.

RESULTS

The study analyzed a total of 196 patients aged 18 to 60 years who presented with renal calculi and underwent ultrasonographic evaluation at two tertiary care centers in Peshawar. The majority of participants belonged to the 31–40 years age group (35.7%), followed by the 20–30 years group (30.6%), 41–50 years group (21.9%), and 51–60 years group (3.6%). Males comprised 61.2% of the sample, while females accounted for 38.8%. Urban residents represented 55.1% of the study population, with 44.9% from rural areas. Renal stones were identified in 17% of patients with acute renal colic, a condition resulting from restricted urine flow and subsequent elevation in intraluminal pressure. The predominant symptom was renal colic, reported in 90.8% of participants. Other associated symptoms included lower back pain (38.8%), hematuria (25.5%), nausea and vomiting (25.5%), groin discomfort (18.4%), polyuria (15.8%), and restlessness (11.2%). In terms of symptom severity, 51% reported moderate symptoms, 20.4% mild symptoms, and 18.9% severe symptoms. Ultrasound was used as the primary diagnostic tool in 88.8% of cases, with an overall diagnostic accuracy of 83.2%. Among those evaluated, 39.8% were confirmed to have renal colic based on imaging, while 60.2% were not diagnosed with the condition. Analysis of lifestyle factors revealed that 52% of participants consumed four to six glasses of water daily, 28.6% drank seven to nine glasses, and 12.2% consumed fewer than four glasses per day. A high intake of salty or sugary foods was noted in 58.2% of individuals. While 59.2% consumed oxalate-rich foods infrequently, 57.1% had a low intake of calcium-rich foods. Only 6.6% reported avoiding processed or salty foods entirely, whereas 71.9% consumed them occasionally. Family history of kidney stones was present in 54.1% of participants. The prevalence of comorbid conditions included obesity (24.5%), hypertension (21.4%), gout (12.2%), and diabetes (9.7%), while 32.1% of the population had no known pre-existing conditions.

Chi-square analysis showed no significant association between renal colic and age (p = 0.090), gender (p = 0.942), or area of residence (p = 0.077). However, a statistically significant relationship was observed between renal colic and lower water intake (p < 0.001). Similarly, frequent consumption of salty or sugary foods (p < 0.001), oxalate-rich foods (p = 0.001), and processed foods (p = 0.001), along with low dietary calcium intake (p < 0.001), were significantly associated with the presence of renal calculi. Additionally, the presence of comorbidities such as diabetes, hypertension, obesity, and gout showed a significant correlation with renal colic (p = 0.016), suggesting that these health conditions may contribute to stone formation. Multivariate logistic regression analysis was conducted to identify independent predictors of renal colic among the study population. Statistically significant associations were observed between renal colic and several modifiable risk factors. Variables such as low water intake, high intake of salty or sugary foods, low dietary calcium intake, consumption of oxalate-rich and processed foods, and the presence of comorbid conditions (including obesity, hypertension, diabetes, and gout) were found to have a significant impact on the likelihood of developing renal calculi. The odds ratios and corresponding 95% confidence intervals for these predictors have been presented to quantify the strength of association. These findings underscore the importance of targeted lifestyle modifications and clinical interventions in reducing the burden of renal stone disease.

Table 1 Demographic Data

Age Group	Gender	Residence	Frequency (n)	Percentage (%)
20-30 years			59	30.6
31-40 years			69	35.7
41-50 years			42	21.9
51-60 years			7	3.6
	Male		119	61.2
	Female		76	38.8
		Urban	107	55.1
		Rural	88	44.9

Table 2: Logistic Regression Results

	Odds Ratio	2.5% CI	97.5% CI	p-value
const	0.405	0.163	1.009	0.052
Low water intake	1.172	0.462	2.971	0.738
High salt sugar intake	0.700	0.383	1.281	0.248
Low calcium intake	1.636	0.871	3.071	0.125
Oxalate food intake	0.668	0.353	1.263	0.214
Processed food intake	0.915	0.488	1.712	0.781
Comorbid conditions	1.889	0.987	3.613	0.054

Table 3: Prevalence of Study Variables

Variable	Prevalence (%)
Renal Colic	37.2
Low Water Intake	11.7
High Salt/Sugar Intake	52.6
Low Calcium Intake	63.3
Oxalate-rich Food Intake	35.2
Processed Food Intake	65.3
Comorbid Conditions	64.3

Table 4: Chi-square Analysis

Variable	Chi-square	Degrees of Freedom	p-value
Low Water Intake	0	1	1
High Salt/Sugar Intake	2.07	1	0.1503
Low Calcium Intake	1.75	1	0.1859
Oxalate-rich Food Intake	0.979	1	0.3224
Processed Food Intake	0.003	1	0.9571
Comorbid Conditions	2.951	1	0.0858

Daily Water Intake Among Participants

Pre-existing Medical Conditions in Participants

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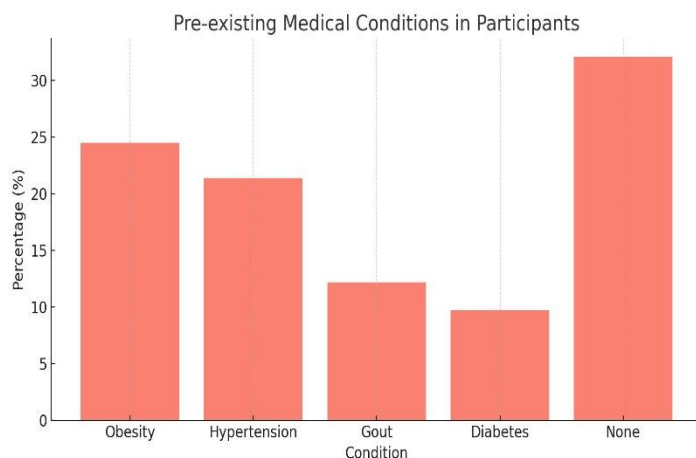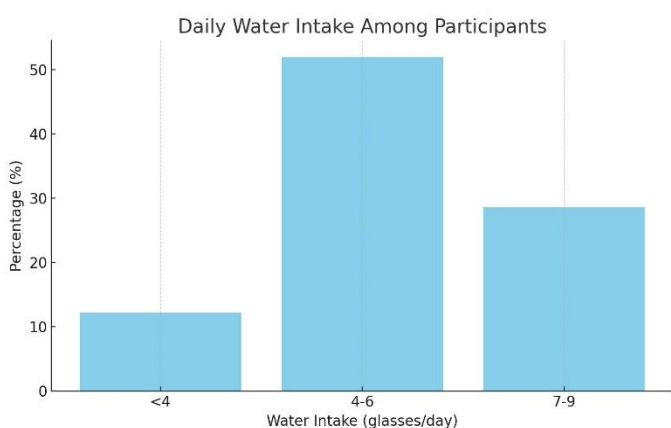
DISCUSSION

Renal colic, a clinical manifestation of ureteric obstruction caused by calculi, demonstrated clear demographic and lifestyle-related patterns in this study. The analysis revealed that individuals between 31 and 40 years of age were the most frequently affected, with a higher prevalence among males. These findings are consistent with earlier studies conducted in diverse geographical contexts, which reported a peak incidence of renal colic in middle-aged adults (12). Although several studies have supported a male predominance, some have noted comparable prevalence rates between sexes. These discrepancies likely arise from variations in dietary patterns, occupational exposure, hormonal influences, and genetic predisposition across different populations (13). Ultrasound, used as the primary diagnostic modality in this study, demonstrated high diagnostic performance in detecting renal calculi, with accuracy metrics comparable to existing literature. While previous research has shown variability in sensitivity and specificity values, ultrasound remains a practical, accessible, and non-invasive imaging tool, particularly in resource-constrained settings (14). However, its limitations in identifying small or distal ureteric stones highlight the complementary role of computed tomography (CT) in enhancing diagnostic precision. Despite its recognized utility, reliance solely on ultrasonography may result in underdiagnosis or misclassification in certain clinical scenarios (14,15).

A key strength of this study lies in its comprehensive analysis of lifestyle and dietary factors associated with renal colic. Statistically significant associations were identified between renal colic and inadequate water intake, high consumption of salty and sugary foods, low calcium intake, and frequent intake of processed and oxalate-rich foods. These results are well-supported by previous investigations that identified dehydration and dietary imbalances as modifiable risk factors for stone formation (16). The logistic regression model reinforced these associations, showing that low daily water intake markedly increased the risk of renal colic, while higher water consumption had a protective effect. Conversely, excessive calcium and oxalate intake were independently associated with an elevated risk, emphasizing the central role of dietary habits in stone pathogenesis (17). Notably, the presence of comorbidities such as hypertension, obesity, gout, and diabetes were also significantly associated with renal colic. These conditions may contribute to altered urinary composition and impaired renal function, further facilitating stone formation (18). Although their influence appeared less pronounced than dietary factors, the co-existence of these metabolic disorders warrants clinical attention and reinforces the need for a multidisciplinary approach to prevention and management. The absence of a significant association with age, sex, and residency underscores the importance of lifestyle factors as primary contributors to renal stone formation, regardless of demographic variables (19).

This study's strengths include its adequate sample size, real-time data collection through face-to-face interviews, and structured assessment of both clinical and lifestyle factors. The use of validated data collection tools and standardized imaging protocols enhanced internal consistency and diagnostic reliability. However, several limitations must be acknowledged. The cross-sectional design restricts causal inference, and reliance on self-reported dietary data introduces potential recall bias. Although ultrasound was used consistently across centers, inter-operator variability and absence of confirmatory CT imaging may have influenced diagnostic outcomes. Future studies should consider longitudinal designs to assess the temporal relationship between dietary patterns and stone recurrence. Inclusion of biochemical stone analysis and assessment of seasonal variations could further elucidate environmental and metabolic contributors. Evaluating hydration patterns with objective measures, such as urine output or osmolality, would offer a more precise understanding of fluid-related risk. Moreover, research should explore genetic markers of stone susceptibility and examine interactions between hereditary predisposition and modifiable lifestyle factors across diverse populations. The findings of this study emphasize the importance of patient education and public health interventions focused on modifiable risk factors. Adequate hydration, dietary balance, and control of comorbid conditions must be prioritized in clinical practice to reduce the burden of renal colic. Strategic preventive efforts tailored to individual risk profiles can contribute significantly to reducing disease recurrence, healthcare costs, and overall morbidity associated with urolithiasis (20).

CONCLUSION

This study highlights important associations between renal colic and modifiable lifestyle factors, particularly hydration status and dietary habits. The findings emphasize that inadequate water intake, frequent consumption of salty, sugary, calcium-rich, and oxalate-rich foods, along with a positive family history, are key contributors to the risk of kidney stone formation. While the cross-sectional nature and reliance on self-reported data limit the ability to establish causation, the results support the importance of preventive strategies centered around healthier dietary choices and improved hydration. These insights are valuable for guiding clinical practice and public health education aimed at reducing the burden of renal colic through early risk assessment and behavioral interventions.

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Author Contribution:

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Habiba Alam Khan	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Nimra Amin	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published

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