Original Article

DOI: 10.7860/JCDR/2026/84805.24213

Urology Section

Impact of Diet and Occupation on Kidney Stone Formation: A Cross-sectional Study

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ABSTRACT

Introduction: Nephrolithiasis is a growing global health concern influenced by genetic, dietary and lifestyle factors. Excessive meat intake, genetic predisposition and occupational conditions contribute significantly to stone formation and recurrence. However, few studies in India have examined their combined impact.

Aim: To evaluate the role of dietary patterns and occupational activity in renal stone formation.

Materials and Methods: This cross-sectional study was conducted Department of Microbiology at Chettinad Hospital and Research Institute, Chettinad Academy of Research and Education, Kelambakkam, Tamil Nadu, India, from October 2023 to February 2025. A total of 90 patients with renal stones, including both first-time stone formers (n=46) and recurrent cases (n=44), were enrolled. A structured questionnaire was used to gather dietary information. Fourier Transform Infrared Spectroscopy (FTIR) analysis was performed on 50 stone samples to determine their mineral composition. To determine associations among variables, Pearson's Chi-square test was performed and results with $p<0.05$ were deemed statistically significant.

Results: Of the 90 patients included, 56% were males and the majority were aged 31-45 years. Recurrent stone formers exhibited significantly higher meat consumption ($\chi^2=11.9$, $p\leq0.05$) and a stronger family history of renal calculi ($\chi^2=6.62$, $p\leq0.01$). Sedentary occupations were more prevalent among first-time stone formers, whereas physically demanding jobs were more common among recurrent cases ($\chi^2=12.64$, $p\leq0.001$).

Conclusion: The findings highlight that dietary habits and both sedentary and physically demanding occupations play crucial roles in renal stone occurrence.

Keywords: Calculi, Infrared, Sedentary lifestyle, Spectroscopy, Recurrence, Urolithiasis

INTRODUCTION

The prevalence of nephrolithiasis is steadily increasing worldwide, making nephrolithiasis the third most common urinary tract disorder after infections and prostate-related conditions [1,2]. Renal stones are solid mineral deposits that form in the urinary system and can be classified as calcium oxalate, uric acid, struvite, cystine, or mixed based on their composition [3]. Global prevalence varies significantly, with the highest rates of 7-13% observed in North America, followed by 5-9% in Europe and 1-5% in Asia [3].

Dietary habits, particularly high animal protein intake, are well-recognised contributors to stone formation. Excessive consumption of red meat increases urinary excretion of uric acid, calcium and oxalate, promoting crystal aggregation and stone development [4]. Additionally, genetic predisposition plays a crucial role in nephrolithiasis, with familial clustering suggesting hereditary susceptibility [5]. Specific genetic polymorphisms associated with calcium metabolism, oxalate transport and urinary citrate levels have been implicated in stone pathogenesis [6]. Apart from diet, both sedentary lifestyles and physically demanding occupations have been identified as influential contributors to renal stone formation, though through different mechanisms. Physical inactivity disrupts calcium homeostasis, reduces urinary citrate levels and contributes to metabolic disorders such as obesity and insulin resistance, all of which enhance stone risk [7]. While sedentary lifestyles have been linked to an increased risk of kidney stone formation, emerging evidence also suggests that physically demanding occupations, particularly in hot environments, may contribute to recurrence due to chronic dehydration [8]. However, the literature remains divided, with one study reporting no significant association between physical inactivity and nephrolithiasis [9]. Despite the well-established roles of diet and occupational behaviour in renal stone formation, few studies, particularly in India, have examined their combined impact. The present study aimed to investigate the interplay between high meat consumption, genetic susceptibility and occupation in the pathogenesis of renal stones.

MATERIALS AND METHODS

This cross-sectional study was conducted at Chettinad Hospital and Research Institute, Chettinad Academy of Research and Education, Kelambakkam, Tamil Nadu, India, from October 2023 to February 2025. Patient recruitment, clinical evaluation and collection of questionnaire data were conducted among patients with renal stones attending the Department of Urology. The laboratory processing and FTIR-based compositional analysis of retrieved renal stone samples were performed in the Department of Microbiology. The study was conducted in accordance with ethical guidelines and approved by the Institutional Human Ethics Committee (IHEC-II/0388/23).

Inclusion and Exclusion criteria: Patients diagnosed with renal stones, either as first-time formers or those with recurrence, who provided informed consent and were willing to complete questionnaires on diet, occupation and lifestyle were included. Participants under 18 years of age were included if parental consent was obtained. Individuals with other major urological conditions, renal transplant history, significant co-morbidities, pregnant women and those unable to provide reliable dietary or occupational information were excluded.

Sample size calculation: The sample size was estimated using the formula n=4PQ/L2n=4PQ/L^2n=4PQ/L2, where P represents prevalence, Q=1–P and L is the allowable error. Based on a reported prevalence of 6.4% from a previous epidemiological study [10], the calculated sample size was 96, which was rounded to 100.

However, due to the time-bound nature of the study and the use of convenience sampling, 90 eligible and consenting participants were included in the final analysis. This is acknowledged as a limitation that may affect the generalisability of the findings.

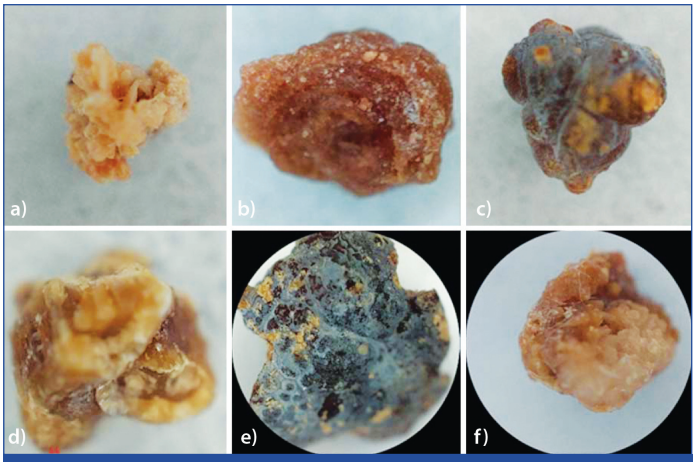
Study Procedure

A total of 90 patients diagnosed with renal stones (including both first-time stone formers and recurrent cases) were enrolled, with data collected through patient interviews, clinical records and laboratory analyses. Recurrent stone formers were defined as patients who had experienced two or more documented episodes of renal stones, confirmed through imaging or medical records, with a minimum interval of six months between episodes. FTIR analysis was performed for only 50 of 90 patients because sufficient intact stone material was available for laboratory examination. In the remaining cases, most patients underwent Percutaneous Nephrolithotomy (PCNL), during which the stones were fragmented into fine powder within the kidney, particularly when the stones were small (4-5 mm). As a result, adequate and retrievable stone specimens could not be obtained for FTIR analysis. Therefore, only those patients from whom intact or adequately sized stone fragments were recovered and who provided consent were included in the FTIR-based compositional analysis.

Data collection: Data were collected systematically from 90 patients using a structured questionnaire covering demographic details such as age, gender and Body Mass Index (BMI), as well as medical history, including co-morbidities such as diabetes, hypertension and obesity and a family history of urolithiasis. The questionnaire was developed by the authors, drawing on previously published studies to ensure the relevance of items on diet, lifestyle and occupational factors [11,12]. Lifestyle factors relevant to the study objectives, including physical activity levels associated with occupational category and dietary intake patterns (meat), were recorded and analysed. Dietary intake was assessed using a semi-quantitative, frequency-based approach, categorising food consumption into predefined groups: 1-2 times per week, 2-4 times per week, more than five times per week, or none. All questionnaires were interviewer-administered by a trained investigator to minimise recall bias, ensure uniform interpretation of questions and reduce interrater variability. Since the same investigator collected all data, an interrater reliability assessment was not applicable.

FTIR analysis [13]: The FTIR is an analytical method to examine the infrared absorption, emission and photoconductive properties of solid materials such as renal stones. This technique helps detect both organic and inorganic constituents present in the sample. FTIR is vital in analysing unknown substances, identifying impurities, tracing additive components and assessing chemical degradation or oxidation. The identification process is based on the infrared absorption pattern within the frequency range of 400-4000 cm^{-1}, which reflects the presence of specific molecular functional groups. FTIR analysis was performed by the same investigator who collected the stone samples.

Sample preparation and analysis of renal calculi: Proper preparation of renal stone specimens is essential for accurate FTIR interpretation. Upon receipt in sterile containers, the stones were rinsed with deionised water to remove external contaminants and air-dried on sterile gauze. Subsequently, they were oven-dried at 60°C for one hour to eliminate residual moisture and then photographed for documentation [Table/Fig-1]. Larger stones were fractured using a sterile mortar and pestle to access internal layers. The powdered samples were mixed with potassium bromide (KBr) and compressed into pellets using a hydraulic press. Both the core and surface components were analysed separately to detect compositional variation.



[Table/Fig-1]: Macroscopic appearance of six different renal calculi samples.

STATISTICAL ANALYSIS

All statistical analyses were performed using International Business Machines (IBM) Statistical Packages of Social Sciences (SPSS) Statistics version 25.0. A Pearson's Chi-square test was conducted to assess the association between physical activity levels and renal stone formation, as well as other categorical variables. Statistical significance was defined as a p-value less than 0.05.

RESULTS

A total of 90 patients were included, with 46 experiencing renal stones for the first-time and 44 presenting with recurrence [Table/Fig-2].

Variables	First-time (n=46)	Recurrent (n=44)	Total (N=90)
Age (years) (Mean±SD)	43±15.7	44±13	44±14.3
Gender (Male/Female)	24/22	26/18	50/40
BMI (Mean±SD)	29±4.2	29±5	29±4.4
Diabetes	2	3	5
Hypertension	8	2	10
Obesity	27	22	49
Multiple co-morbidities	9	17	26
Family history of renal stones n (%)	6 (13%)	16 (36%)	22 (24%)

[Table/Fig-2]: Baseline characteristics of study participants.

The age distribution was similar across groups, except for one recurrent case in a 15-year-old patient. Although one recurrent case belonged to the paediatric age group (15 years), separate statistical analysis was not performed due to the extremely small number of cases in this category. Gender-wise distribution showed a slight male predominance in both groups (52% in first-time and 59% in recurrence cases, χ^2=0.44, p=0.50) [Table/Fig-3].

Back pain and abdominal pain were the most common presenting symptoms in both first-time and recurrent renal stone patients. Elevated serum creatinine levels were observed more frequently among first-time stone formers (39.1%) compared to recurrent stone formers (10.7%). Serum creatinine analysis was performed only among patients with available biochemical data (First-time: n=23; Recurrent: n=28). Due to incomplete availability across all participants, creatinine levels were not included in comparative statistical analysis. Additional clinical details, including co-morbid conditions and medication history, were recorded but excluded from quantitative analysis because of non uniform distribution. Surgical management predominantly involved Ureteroscopic Lithotripsy (URSL) in both groups, while PCNL was required in a smaller proportion of patients. All the details has been shown in [Table/Fig-4].

A significant association was observed in meat consumption patterns, where recurrent stone formers had a markedly higher intake of meat 2-4 times per week compared to first-time cases

Characteristics	First-time (n=46)	Recurrence (n=44)	Total (N=90)	p-value
Gender				
Males n (%)	24 (52%)	26 (59%)	50 (56%)	(χ^2=0.44) p=0.50
Females n (%)	22 (48%)	18 (41%)	40 (44%)	
Age (years)				
0-15	0	1 (2%) (1 Female)	1 (1%)	(χ^2=3.81) p=0.4
16-30	10 (22%) (5 Male and 5 Female)	6 (14%) (4 Male and 2 Female)	16 (18%)	
31-45	19 (41%) (11 Male and 8 Female)	21 (48%) (15 Male and 6 Female)	40 (45%)	
46-60	9 (20%) (4 Male and 5 Female)	12 (27%) (6 Male and 6 Female)	21 (23%)	
>61	8 (17%) (4 Male and 4 Female)	4 (9%) (1 Male and 3 Female)	12 (13%)	

[Table/Fig-3]: Demographic characteristics of first-time and recurrent renal stone patients.

Parameters	First-time stone formers 46 (51%)	Recurrent stone formers 44 (49%)
Presenting symptoms (n)		
Back pain	44	43
Abdominal pain	46	44
Serum creatinine status n (%)		
Normal	14 (60.9%)	25 (89.3%)
Elevated	9 (39.1%)	3 (10.7%)
Surgical intervention		
PCNL	17	14
URSL	29	30
Not on regular long-term medication before hospital admission	43	41

[Table/Fig-4]: Clinical presentation and management characteristics among first-time and recurrent renal stone patients.
PCNL: Percutaneous nephrolithotomy; URSL: Ureteroscopic lithotripsy
Creatinine reference ranges- Males: ≤1.3 mg/dL and Females: ≤1.1 mg/dL

χ^2=11.9, p=≤0.05. A notable finding was the significantly higher prevalence of family history of renal calculi in recurrent cases (36%) compared to first-time cases (13%) χ^2=6.62, p≤0.01, All these findings are detailed in [Table/Fig-5].

In assessing potential predisposing factors for renal stone formation, a few clinically relevant findings were observed. Among first-time stone formers, three patients had a history of urinary retention, while one patient, with longstanding hemiparalysis, had been on chronic catheterisation for six years. In both groups, one patient each had a history of heart surgery. In the recurrence group, elevated calcium and creatinine levels were noted in one patient each. Recurrent Urinary Tract Infections (UTIs) were observed in one first-time case (the catheterised patient) and three recurrent cases. Although no structural abnormalities or prior urological surgeries were reported, these functional and systemic conditions could have contributed to the stone.

Characteristics	First-time	Recurrence	p-value
Participants (n)	46	44	
Meat Intake			
1-2 times/week	14 (30%)	2 (5%)	(χ^2=11.9) p≤0.05
2-4 times/week	15 (33%)	25 (57%)	
More than 5 times/week	5 (11%)	7 (16%)	
No	12 (26%)	10 (23%)	
Family history of renal calculi			
Yes	6 (13%)	16 (36%)	(χ^2=6.62) p≤0.01
No	40 (87%)	28 (64%)	
Water Intake			
1-2 L	15 (31%)	17 (39%)	(χ^2=0.80) p=0.67
2-4 L (Adequate)	23 (50%)	22 (50%)	
More than 4 L	8 (17%)	5 (11%)	

[Table/Fig-5]: Clinical and lifestyle profiles of first-time and recurrent renal stone patients Values presented as n (%).

Among first-time stone formers, the majority (32 patients) were engaged in sedentary jobs, whereas in the recurrence group, only 17 patients had similar occupational patterns [Table/Fig-6]. No missing data were observed for the variables included in the analysis and all 90 patients completed the study without loss to follow-up.

Characteristics	First-time (n=46)	Recurrence (n=44)	p-value
Sedentary (Office workers, information technology professionals, retirees, etc.)	32 (70%)	17 (39%)	(χ^2=12.64) p=≤0.001
Moderate (Teachers, shopkeepers, drivers, etc.)	7 (15%)	5 (11%)	
Highly active jobs (Farmers, construction workers, welders, military personnel, etc.)	7 (15%)	22 (50%)	

[Table/Fig-6]: Distribution of occupational categories among first-time and recurrent renal stone patients. Values presented as n (%).

The FTIR analysis of 50 renal stone samples revealed that calcium stones were the most common accounting for 25 samples (50%), followed by struvite stones in 9 (18%) samples and mixed composition stones in 9 (18%) samples [Table/Fig-7].

Spectral curves were obtained using Opus software and peak detection and analysis were performed with OriginPro 2024 [Table/Fig-8].

DISCUSSION

In the present study, a higher prevalence of nephrolithiasis was observed among males (56%) compared to females (44%). This finding is consistent with Keshavarzi B et al., (2015), who also reported male predominance in urinary stone formation, attributing it to higher urinary calcium excretion, lifestyle and dietary influences. The highest incidence of renal calculi occurred in the 31-45-year age group (45%), followed by 46-60 years (23%). These findings are comparable to those of Keshavarzi B et al., (2016), who reported peak occurrence between 40-60 years [14].

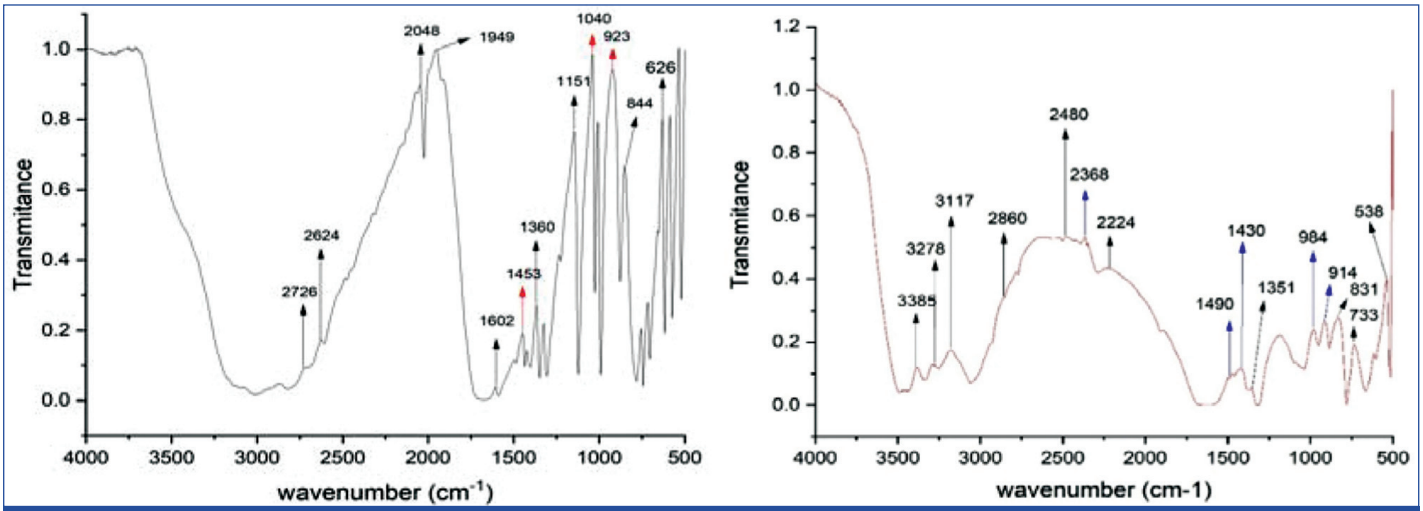
Back pain and abdominal pain were the most frequently reported symptoms in both first-time and recurrent stone formers, which is consistent with earlier studies on the clinical presentation of urolithiasis [15]. In the present study, first-time stone formers exhibited a notably higher proportion of elevated serum creatinine levels compared with recurrent stone formers, which may reflect transient renal function impairment at initial obstruction; similar transient elevations in serum creatinine at the time of a first stone event have been documented and suggested to represent acute functional changes secondary to obstruction, even if they resolve later [16].

A significant association was found between family history and recurrent stone formation. Unno R et al., (2023) reported that the percentage of patients experiencing at least one recurrent stone event was higher in patients with a family history of stones (38%) than in those without (28%) over a median follow-up period of eight months (p=0.001) [17]. Halbritter J et al., (2015) also identified genetic variations associated with nephrolithiasis [18].

Clinical conditions such as urinary retention were noted in three first-time patients, while one hemiparalysis patient had chronic catheterisation for six years, both of which predispose to stone

Stone type	First-time cases (n=26)	Male/Female	Recurrent cases (n=24)	Male/ Female	Total N (%)
COM and COD (Calcium)	14 (54%)	10/4	11 (46%)	5/6	25 (50%)
Carbonate Apatite + Other Compositions (Calcium)	1 (4%)	1/0	1 (4%)	0/6	2 (4%)
Uric Acid + Other Compositions (Uric acid)	2 (8%)	2/0	1 (4%)	1/0	3 (6%)
Ammonium Urate + Magnesium Ammonium Phosphate (Struvite)	4 (15%)	3/11	5 (21%)	3/2	9 (18%)
Calcium Oxalate + Carbonate Apatite + Ammonium Urate (Mixed)	4 (15%)	3/11	5 (21%)	1/4	9 (18%)
Protein + Other Compositions (Others)	1 (4%)	0/1	1 (4%)	0/4	2 (4%)
Total	26 (100%)	0/1	24 (100%)	0	50 (100%)

[Table/Fig-7]: Comparative FTIR analysis of renal stones in first-time and recurrent cases.
COM: Calcium oxalate monohydrate; COD:Calcium oxalate dihydrate



[Table/Fig-8]: FTIR analysis of renal calculi samples in the region 400-4000 $^{cm-1}$.

formation and infection through urinary stasis. Kim JY et al., (2022) reported that retained ureteral stents increased the risk of bacteriuria and UTIs, underlining the need to manage urinary stasis [19].

Occupational activity levels influenced stone occurrence. Sedentary occupations were more common among first-time formers, whereas physically demanding jobs were more common in recurrent cases. NHANES 2007-2016 data similarly showed higher kidney stone prevalence in individuals with prolonged sitting and low activity, highlighting sedentary lifestyle as a risk factor [20]. Conversely, Borghi L et al., found a higher prevalence among heat-exposed workers in the glass industry (8.5% vs. 2.4% i.e., in non heat exposed), attributing it to dehydration and concentrated urine [21].

Occupational and lifestyle factors also influenced the risk of recurrence. Although water intake showed no significant association with recurrence, a higher proportion of recurrent cases occurred in physically demanding jobs, likely due to dehydration from heat exposure and fluid loss. Venugopal V et al., conclude that high heat stress combined with heavy workloads and chronic dehydration are high-risk factors for adverse renal health and call for urgent cooling interventions, enhanced welfare facilities and protective labour policies [22].

A key strength of the present study is the inclusion of both first-time and recurrent stone formers, which allowed comparison of clinical and lifestyle characteristics between the two groups. In addition, the study evaluated dietary intake patterns and occupational exposure, which are important yet often underexplored factors in renal stone disease. However, larger multicentre studies with longer follow-up periods are recommended to further validate these findings and to better understand the role of dietary and occupational risk factors in the recurrence of renal stones.

Limitation(s)

The present study is a cross-sectional study, so causal relationships between dietary and occupational factors and kidney stone formation cannot be established. The study was conducted at a single centre, which may restrict the generalisability of the findings. Dietary and occupational exposures were assessed using self-reported information, which may have introduced recall bias.

CONCLUSION(S)

Renal stone recurrence is influenced by diet, family history, physical activity and stone composition. Recurrent cases were associated with higher meat consumption and a strong familial history. Occupational influences were significantly linked to stone formation, emphasising the role of physical activity in prevention. FTIR analysis confirmed calcium oxalate as the predominant stone type in both first-time and recurrent cases, while complex mixed stones suggest multiple metabolic and dietary contributors. These findings highlight the need for targeted prevention strategies, including dietary modifications, hydration and lifestyle adjustments, to reduce recurrence and improve patient outcomes.

Authors' contribution: The study was conceptualised by AM and PS Shanmugam. Methodology, formal analysis and investigation were carried out by AM. The original draft of the manuscript was prepared by AM. Review and editing were conducted by PS. Overall supervision was provided by PS and PP.

REFERENCES

[1] Khalili P, Jamali Z, Sadeghi T, Esmaeili-Nadimi A, Mohamadi M, Moghadam-Ahmadi A, Ayoobi F, Nazari A. Risk factors of kidney stone disease: A cross-sectional study in the southeast of Iran. BMC urology. 2021;21(1):141.
[2] Sorokin I, Mamoulakis C, Miyazawa K, Rodgers A, Talati J, Lotan Y. Epidemiology of stone disease across the world. World Journal of Urology. 2017;35(9):1301-20.
[3] Mohankumar A, Ganesh R, Shanmugam P. Exploring the connection between bacterial biofilms and renal calculi: A comprehensive review. Journal of Pure & Applied Microbiology. 2024;18(4):2262-83.
[4] Lin BB, Lin ME, Huang RH, Hong YK, Lin BL, He XJ. Dietary and lifestyle factors for primary prevention of nephrolithiasis: A systematic review and meta-analysis. BMC Nephrology. 2020;21(1):267.
[5] Thorleifsson G, Holm H, Edvardsson V, Walters GB, Styrkarsdottir U, Gudbjartsson DF, et al. Sequence variants in the CLDN14 gene associate with kidney stones and bone mineral density. Nature Genetics. 2009;41(8):926-30.
[6] Howles SA, Wiberg A, Goldsworthy M, Bayliss AL, Gluck AK, Ng M, et al. Genetic variants of calcium and vitamin D metabolism in kidney stone disease. Nature Communications. 2019;10(1):5175.

[7] Sorensen MD, Chi T, Shara NM, Wang H, Hsi RS, Orchard T, et al. Activity, energy intake, obesity, and the risk of incident kidney stones in postmenopausal women: A report from the Women's Health Initiative. Journal of the American Society of Nephrology. 2014;25(2):362-69.
[8] Ferraro PM, Curhan GC, Sorensen MD, Gambaro G, Taylor EN. Physical activity, energy intake and the risk of incident kidney stones. The Journal of Urology. 2015;193(3):864-68.
[9] Chen JX, Yu XX, Ye Y, Yang XB, Tan AH, Xian XY, et al. Association between recreational physical activity and the risk of upper urinary calculi. Urologia Internationalis. 2017;98(4):403-10.
[10] Vigneshvar C, Dongre AR, Deshmukh P. Epidemiology of renal stone disease among adults in a peri-urban locality of Pondicherry. Australasian Medical Journal (Online). 2013;6(4):266.
[11] Zhuo D, Li M, Cheng L, Zhang J, Huang H, Yao Y. A study of diet and lifestyle and the risk of urolithiasis in 1,519 patients in Southern China. Medical Science Monitor: International Medical Journal of Experimental and Clinical Research. 2019;25:4217.
[12] Shabani E, Khorshidi A, Sayehmiri K, Moradi K, Abdolyousefi EN. The effect of nutritional factors on urolithiasis: A case-control study. Journal of Medicine and Life. 2023;16(7):1062.
[13] Sevil Durdağı S, Jubayir H. Urinary stone composition analyses using Fourier Transform Infrared (FTIR) spectrometry. J Urol Ren Dis. 2024;09:1380.
[14] Keshavarzi B, Yavar Ashayeri N, Moore F, Irani D, Asadi S, Zarasvandi A, et al. Mineralogical composition of urinary stones and their frequency in patients: Relationship to gender and age. Minerals. 2016;6(4):131.
[15] Vedala SB, Thota KS, Gottumukkala VD, Vanga DH, Maisala SK, Giduturi SR. Clinical evaluation and management of recurrent renal stones-a prospective study. CME Journal Geriatric Medicine. 2025;17:147-56.
[16] Haley WE, Enders FT, Vaughan LE, Mehta RA, Thoman ME, Vrtiska TJ, et al Kidney function after the first kidney stone event. Mayo Clin Proc. 2016;91(12):1744-52.
[17] Unno R, Taguchi K, Hosier G, Usawachintachit M, Sui W, Yang H, et al. Maternal family history of urolithiasis is associated with earlier age of onset of stone disease. World Journal of Urology. 2023;41(1):241-47.
[18] Halbritter J, Baum M, Hynes AM, Rice SJ, Thwaites DT, Gucev ZS, et al. Fourteen monogenic genes account for 15% of nephrolithiasis/nephrocalcinosis. Journal of the American Society of Nephrology. 2015;26(3):543-51.
[19] Kim JY, Yeo JK, Park MG, Sung LH, Cho DY, Yu JH. Determination of microbiological characteristics and risk factors associated with bacteriuria and symptomatic urinary tract infection in patients with retained ureteral stents: An observational study. Translational Andrology and Urology. 2023;12(1):9-32.
[20] Li Y, Di X, Liu M, Wei J, Li T, Liao B. Association between daily sitting time and kidney stones based on the National Health and Nutrition Examination Survey (NHANES) 2007-2016: A cross-sectional study. International Journal of Surgery. 2024;110(8):4624-32.
[21] Borghi L, Meschi T, Amato F, Novarini A, Romanelli A, Cigala F. Hot occupation and nephrolithiasis. The Journal of Urology. 1993;150(6):1757-60.
[22] Venugopal V, Latha PK, Shanmugam R, Krishnamoorthy M, Srinivasan K, Perumal K, et al. Risk of kidney stone among workers exposed to high occupational heat stress-A case study from southern Indian steel industry. Science of The Total Environment. 2020;722:137619.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Jan 10, 2026
- Manual Googling: May 02, 2026
- iThenticate Software: May 04, 2026 (2%)

ETYMOLOGY: Author Origin

EMENDATIONS: 9

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Oct 08, 2025**
Date of Peer Review: **Jan 16, 2026**
Date of Acceptance: **May 06, 2026**
Date of Publishing: **Aug 01, 2026**