

## MODIFIABLE LIFESTYLE-RELATED RISK FACTORS ASSOCIATED WITH UROLITHIASIS: A CROSS-SECTIONAL STUDY FROM A TERTIARY CARE CENTER IN NORTH INDIA

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### ABSTRACT

**Background:** Urolithiasis is a frequently encountered urological condition and its burden has been increasing worldwide over recent decades. The development of urinary stones is influenced by several metabolic, environmental, and lifestyle-related factors. Understanding modifiable determinants is essential for planning preventive measures and reducing disease recurrence. The present study was undertaken to evaluate the association of modifiable lifestyle-related factors with urolithiasis and to examine their relationship with stone composition in patients treated at a tertiary care centre in North India. **Materials and Methods:** A hospital-based cross-sectional study was carried out over a period of 18 months at a tertiary care institution in North India. Two hundred patients with symptomatic urolithiasis requiring surgical or endourological management were included in the study. Information regarding body mass index, smoking habits, alcohol consumption, dietary pattern, and residential background was collected using a predesigned proforma. Stone specimens retrieved after intervention were subjected to qualitative biochemical analysis and classified as calcium, struvite, or uric acid stones. Statistical analysis was performed using the Chi-square test, and a p-value of less than 0.05 was considered significant. **Result:** Among the 200 patients studied, calcium stones constituted the majority (57%), followed by uric acid stones (23.5%) and struvite stones (19.5%). Most patients were in the 21–40 years age group (44%), and females accounted for 65.5% of cases. Smoking showed a statistically significant association with stone composition (p=0.004). A considerable proportion of patients were overweight (34%) or obese (44%); however, the association between BMI and stone type was not statistically significant (p=0.054). Similarly, dietary habits (p=0.084), alcohol consumption (p=0.187), and area of residence (p=0.07) did not demonstrate significant associations. **Conclusion:** The study identified smoking as an important modifiable factor associated with stone composition. Although obesity and dietary practices did not show statistical significance, their observed trends suggest a possible role in stone formation. Early lifestyle interventions and risk factor modification may help reduce the burden and recurrence of urolithiasis.

## INTRODUCTION

Urolithiasis is among the most prevalent urological disorders worldwide and represents a significant healthcare burden due to its recurrent nature and associated morbidity.<sup>[1]</sup> Over the past few decades,

the incidence and prevalence of urinary stone disease have increased globally, affecting both developed and developing countries.<sup>[2]</sup> Current estimates suggest that the lifetime prevalence ranges from 5% to 15%, with marked geographic variation influenced by environmental, climatic, and dietary factors.<sup>[1,2]</sup>

India contributes substantially to the global burden of urolithiasis, with northern and northwestern regions reporting a higher incidence of stone disease, commonly referred to as the “stone belt.”<sup>[3]</sup> The increasing burden of urolithiasis in these regions has been attributed to climatic conditions, dietary patterns, inadequate hydration, and changing lifestyle habits.

The pathogenesis of urinary stone formation is multifactorial and involves urinary supersaturation, nucleation, crystal aggregation, and crystal retention in the urinary tract.<sup>[4]</sup> Although genetic predisposition and metabolic disorders contribute significantly to stone formation, several important determinants are modifiable and can be targeted for prevention.

Obesity has emerged as an important risk factor for urolithiasis because of its association with metabolic abnormalities, such as hypercalciuria, hyperoxaluria, hyperuricosuria, and hypocitraturia, which create a lithogenic urinary environment.<sup>[5,6]</sup> Similarly, dietary factors such as high animal protein intake, excess salt consumption, oxalate-rich foods, and inadequate water intake significantly alter urinary chemistry and increase stone risk.<sup>[7]</sup>

Smoking has also gained attention as a potential risk factor. Tobacco exposure is associated with oxidative stress, endothelial dysfunction, and renal tubular epithelial injury, all of which may facilitate crystal adherence and retention in the kidneys.<sup>[8]</sup> Alcohol intake has shown inconsistent associations with urolithiasis, largely because of its variable effects on hydration and metabolism.

Environmental and geographic factors further influence the formation of stones. High ambient temperatures and increased perspiration result in concentrated urine and an increased risk of crystallization. Individuals residing in hilly regions may have additional occupational and hydration-related challenges that predispose them to stone disease.<sup>[9]</sup>

Recurrence rates of urolithiasis remain high, with nearly half of patients experiencing recurrence within 5–10 years if preventive measures are not implemented. Therefore, identifying modifiable lifestyle-related risk factors is essential for effective prevention and reducing recurrence.<sup>[2]</sup>

This study aimed to evaluate modifiable lifestyle-related risk factors associated with urolithiasis and assess their association with stone composition among patients undergoing intervention at a tertiary care center in North India.

## MATERIALS AND METHODS

This hospital-based cross-sectional study was conducted in the Department of Surgery (Urology

Unit) at Government Medical College and Dr. Susheela Tiwari Government Hospital, Haldwani, Uttarakhand, over a period of 18 months after obtaining approval from the Institutional Ethics Committee.

A total of 200 consecutive patients diagnosed with symptomatic urolithiasis and who underwent intervention during the study period were included. Written informed consent was obtained from all the participants.

### Inclusion Criteria

Symptomatic urolithiasis patients of all age groups requiring intervention.

### Exclusion Criteria

Patients unwilling to participate in the study.

Asymptomatic patients were managed conservatively.

A structured proforma was used to collect demographic and clinical data, including age, sex, BMI, smoking status, alcohol consumption, dietary habits, and area of residence.

Body mass index was calculated as weight in kilograms divided by height in square meters and classified according to the World Health Organization criteria.<sup>[10]</sup>

Stone samples retrieved after intervention, including extracorporeal shock wave lithotripsy (ESWL), endoscopic procedures, and open surgical procedures, were subjected to qualitative biochemical analysis in the Department of Biochemistry.<sup>[11]</sup> Stones were categorized into calcium, struvite, and uric acid stones based on their predominant composition.

Data were entered into Microsoft Excel and analyzed using the Statistical Package for the Social Sciences (SPSS) version 26.0 (IBM Corp., Armonk, NY, USA). Categorical variables are expressed as frequencies and percentages, and continuous variables are presented as mean ± standard deviation. Associations between categorical variables were assessed using the chi-square test or Fisher’s exact test, wherever applicable. Statistical significance was set at  $p < 0.05$ .

## RESULTS

A total of 200 patients with urolithiasis were included in the analysis. The majority belonged to the 21–40 years age group (44%), followed by the 41–60 years age group (34%). Female patients comprised 65.5% of the study population.

Calcium stones were the predominant stone type (57%), followed by uric acid (23.5%) and struvite stones (19.5%).

**Table 1: Baseline demographic and clinical characteristics**

Variable	Frequency (n=200)	Percentage (%)
Age 0–20 years	16	8
Age 21–40 years	88	44
Age 41–60 years	68	34

Age 61–80 years	28	14
Male	69	34.5
Female	131	65.5
Calcium stones	114	57
Struvite stones	39	19.5
Uric acid stones	47	23.5

Obesity and overweight were common among the study participants, accounting for 44% and 34% of the participants, respectively. Calcium stones were the most common stone type in all BMI categories. Obese individuals showed a relatively higher proportion of calcium and uric acid stones, although the association was not statistically significant ( $P = 0.054$ ).

Smoking was reported in 28% of the patients. A statistically significant association was observed between smoking and stone type ( $P = 0.004$ ), with a relatively higher proportion of uric acid stones among smokers.

Dietary habits showed no statistically significant association ( $P = 0.084$ ), although uric acid stones were relatively more frequent among non-vegetarians.

**Table 2: Association of BMI, smoking, and dietary habits with stone type**

Variable	Calcium n (%)	Struvite n (%)	Uric acid n (%)	p-value
Underweight	4 (3.5)	6 (15.4)	6 (12.8)	0.054
Normal weight	8 (7.0)	10 (25.6)	10 (21.3)	
Overweight	44 (38.6)	11 (28.2)	13 (27.7)	
Obese	58 (50.9)	12 (13.8)	18 (38.3)	
Smoker	30 (26.3)	10 (25.6)	16 (34.0)	0.004
Non-smoker	84 (73.7)	29 (74.4)	31 (66.0)	
Vegetarian	59 (51.8)	18 (46.2)	20 (42.6)	0.084
Non-vegetarian	55 (48.2)	21 (53.8)	27 (57.4)	

Alcohol consumption was reported in 44% of the patients. No statistically significant association was observed between alcohol intake and stone type ( $P = 0.187$ ).

Patients from hilly areas constituted 64.5% of the study population, compared with 35.5% from plain

areas. Although a greater proportion of patients with stone disease was observed in patients from hilly areas, the association with stone type was not statistically significant ( $p = 0.07$ ).

**Table 3: Association of alcohol intake and area of residence with stone type**

Variable	Calcium n (%)	Struvite n (%)	Uric acid n (%)	p-value
Drinkers	53 (46.5)	17 (43.6)	18 (38.3)	0.187
Non-drinkers	61 (53.5)	22 (56.4)	29 (61.7)	
Hilly	73 (64.0)	27 (69.2)	29 (61.7)	0.07
Plain	41 (36.0)	12 (30.8)	18 (38.3)	

## DISCUSSION

The present study evaluated modifiable lifestyle-related risk factors associated with urolithiasis and their relationship with stone composition in a North Indian population. Calcium stones were the most common, followed by uric acid and struvite stones. This pattern is consistent with previous epidemiological studies, in which calcium-based calculi accounted for the majority of urinary stones.<sup>[12]</sup>

The highest prevalence of urolithiasis in the present study was observed in the 21–40 years age group. Similar findings have been reported in earlier studies, indicating that urinary stone disease predominantly affects the economically productive age groups.<sup>[13]</sup> This age-related distribution may be due to occupational stress, dietary habits, and inadequate hydration.

Female predominance was observed in the present study, which differs from the traditionally reported male predominance in urolithiasis.<sup>[12]</sup> This variation

may reflect changing dietary habits, increasing obesity, and altered health-seeking behaviors among women.

Obesity was highly prevalent in the study population. Although the association between BMI and stone type was not statistically significant, obese individuals showed a higher proportion of calcium and uric acid stones. Previous studies have demonstrated that obesity is associated with increased urinary excretion of lithogenic substances, including calcium, oxalate, sodium, and uric acid.<sup>[14,15]</sup> The increasing prevalence of obesity in India may partly explain the growing burden of urolithiasis.

In the present study, smoking was significantly associated with stone type. Smokers had a relatively higher proportion of uric acid stones. Tobacco exposure causes oxidative stress, vascular endothelial dysfunction, and renal tubular injury, all of which may facilitate crystal retention and stone formation.<sup>[16]</sup> Recent meta-analyses have also

supported smoking as a significant modifiable risk factor for urinary stone disease.<sup>[17]</sup>

Dietary habits are well-recognized contributors to the development of stone diseases. In the present study, non-vegetarian dietary habits showed a higher proportion of uric acid stones, although the difference was not statistically significant. High animal protein intake increases urinary uric acid and calcium excretion and reduces citrate excretion, thereby increasing the lithogenic potential.<sup>[18]</sup> The lack of statistical significance in this study may be related to sample size limitations and the absence of a quantitative dietary assessment.

Alcohol consumption did not show a statistically significant association with stone type. The relationship between alcohol consumption and urolithiasis remains controversial. Some studies have suggested an increased risk of dehydration and altered purine metabolism, while others have found no significant association.<sup>[19]</sup> The findings of the present study support the latter observation.

A greater proportion of patients in our study belonged to hilly regions. Although the association with stone type was not statistically significant, environmental factors such as difficult terrain, occupational exertion, and limited hydration may contribute to the stone burden in these regions. Geographic and climatic factors are increasingly recognized as contributors to urolithiasis.

The present study has important clinical implications. Identification of modifiable risk factors, such as smoking, obesity, and dietary habits, can help design preventive strategies aimed at reducing disease burden and recurrence.

This study has certain limitations. As this was a hospital-based cross-sectional study, causal relationships could not be established. The sample included only patients who underwent intervention, which may not represent the entire spectrum of stone disease. Additionally, qualitative biochemical analysis may not be as precise as infrared spectroscopy or X-ray diffraction techniques.

Despite these limitations, this study provides useful insights into modifiable lifestyle-related risk factors associated with urolithiasis and highlights the importance of preventive strategies.

## CONCLUSION

Urolithiasis remains a significant health problem in North India, particularly among young and middle-aged adults, with calcium stones being the predominant stone type. Smoking was significantly associated with stone composition, whereas obesity and dietary habits showed notable trends. Lifestyle modifications, smoking cessation, dietary counseling, and adequate hydration should be emphasized as important preventive measures to reduce the burden and recurrence of urolithiasis.

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