

ASSOCIATION OF NEPHROLITHIASIS WITH DIET IN PAKISTAN

Original Research

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ABSTRACT

Background: Nephrolithiasis, or kidney stone disease, is a growing global health concern characterized by the formation of mineral and salt deposits within the renal system. Lifestyle choices, particularly dietary habits and nutritional status, have been shown to play a pivotal role in both the development and recurrence of kidney stones. Despite its increasing prevalence, limited data exist on the dietary behaviors and associated risk factors of nephrolithiasis patients in regional healthcare settings of Pakistan.

Objective: To assess dietary habits, nutritional status, and associated risk factors in patients diagnosed with nephrolithiasis.

Methods: A descriptive cross-sectional study was conducted at Category A Hospital, Batkhela, from February to May 2022. A total of 200 patients diagnosed with nephrolithiasis were enrolled through consecutive sampling. Data were collected via a structured questionnaire covering socio-demographics, anthropometric measurements, physical activity, and dietary intake patterns. BMI was classified according to WHO 1998 standards. The data were compiled and analyzed using Microsoft Excel 2013 to determine frequencies and percentages.

Results: Out of 200 respondents, 116 (58%) were females and 84 (42%) were males. The majority of the patients (27%) were aged 24–34 years. A total of 175 (87.5%) were married. BMI classification revealed that 34.5% of females and 29.3% of males were overweight, while 16.37% of females and 12.08% of males were extremely obese. Educationally, both the illiterate and bachelor's degree holders accounted for 22% (n=44) each. Among females, 52% were housewives. Dietary intake patterns showed high daily consumption of vegetables and rice, with weekly intake of red meat, beans, and carbonated drinks.

Conclusion: The study underscores the significant association between nutritional status, dietary patterns, and nephrolithiasis. Preventive education focusing on fluid intake, weight management, and dietary modifications is essential to reduce disease burden.

Keywords: Anthropometry, Dietary habits, Kidney calculi, Nutritional assessment, Physical activity, Risk factors, Urinary tract calculi.

INTRODUCTION

Nephrolithiasis, or kidney stone disease, represents a significant and increasingly common urological condition worldwide, characterized by the formation of calculi within the renal tract due to a disturbance in the balance between solubility and precipitation of urinary salts. The disease shares epidemiological and lifestyle parallels with non-communicable diseases such as obesity, hypertension, and type 2 diabetes, positioning it among disorders of affluence, particularly in industrialized nations (1). While kidney stones vary considerably in size, shape, and mineral composition, their chemical makeup is primarily dictated by urinary biochemical anomalies. Based on mineral content and pathophysiology, stones are commonly classified into five major categories: calcium, struvite, uric acid, cystine, and drug-induced types (1,2). Calcium stones, predominantly calcium oxalate (CaOx), comprise up to 80% of all kidney stones and are linked to metabolic imbalances such as hypercalciuria, hyperoxaluria, and hypocitraturia. Acidic urinary pH, ranging between 5.0 and 6.5, favors the formation of CaOx stones, while alkaline urine (pH > 7.5) predisposes to calcium phosphate stones. The high recurrence rate of calcium stones remains a major concern in clinical nephrology (3). Struvite stones, accounting for 10–15% of cases, typically arise in individuals with recurrent urinary tract infections by urease-producing bacteria. Uric acid stones (3–10%) develop in acidic urine and are frequently linked to diets rich in animal protein, especially purines, with a greater prevalence observed in males (4). Less commonly, cystine stones result from a hereditary defect in amino acid transport, while drug-induced stones, although rare, are associated with certain medications including protease inhibitors and sulfa drugs (5). Clinically, nephrolithiasis often presents as a sudden onset of severe, colicky flank pain, frequently radiating toward the groin, and is commonly accompanied by hematuria, nausea, and vomiting. The nature and radiation of pain depend on the stone's location and degree of obstruction. Persistent or localized discomfort can suggest more severe or distal obstruction within the urinary tract (6). A multitude of underlying disorders, such as Dent's disease, medullary sponge kidney, hyperparathyroidism, irritable bowel syndrome, renal tubular acidosis, and sarcoidosis, can predispose individuals to stone formation. Genetic predisposition plays a critical role, with individuals having a family history being 2.5 times more likely to develop stones (7). Environmental influences and dietary practices, including low fluid intake, excessive salt, and protein consumption, further modulate the risk (8).

Despite therapeutic advancements, both the incidence and recurrence of kidney stones are rising globally. Epidemiological data suggest that approximately 12% of individuals will experience nephrolithiasis in their lifetime, with the highest prevalence seen in males aged 20–49 years. Although the gender gap is narrowing, recurrence remains more frequent among males (9). Alarming, the growing burden of nephrolithiasis is now evident in both developed and developing nations, attributed in part to increasingly sedentary lifestyles, unhealthy dietary patterns, and the broader implications of climate change. In the United States alone, over 600,000 individuals are affected annually, while in India, nearly 12% of the population suffers from urolithiasis, often resulting in progressive renal impairment in half of these cases (10). Pakistan, situated in the Afro-Asian stone belt, exhibits a comparably high prevalence of 12%, compounded by a notably high rate of consanguinity exceeding 50%, potentially contributing to inherited forms of the disease (11). Given the clinical and public health burden posed by nephrolithiasis and its rising global incidence, understanding modifiable risk factors remains imperative. Yet, literature focusing on the interplay between nutritional status and the risk of kidney stone formation remains insufficient, particularly in high-risk regions. Therefore, the current study aims to evaluate the nutritional status of patients with nephrolithiasis and to identify associated risk factors contributing to the development of renal calculi.

METHODS

This descriptive cross-sectional study was conducted at Category A Hospital, Batkhela, under the supervision of Consultant Nephrologist Dr. Mohammad Shahid Khan, with the aim of identifying the nutritional status and risk factors associated with nephrolithiasis. The study was conducted over a four-month period from February 2022 to May 2022. A total of 200 patients with confirmed diagnoses of nephrolithiasis were enrolled using a non-probability consecutive sampling method. Inclusion criteria included patients of either sex, aged 18 years and above, with a radiologically or clinically confirmed diagnosis of kidney stones. Patients who were critically ill, unwilling to participate, or had incomplete data records were excluded (1,5). Data were collected through a pre-validated, structured questionnaire administered via direct interviews by trained healthcare staff. The questionnaire was divided into multiple sections to capture a broad range of variables including sociodemographic data (age, gender, education level, marital status, occupation, and

income), clinical history, physical activity level, and anthropometric measures such as height and weight. Body Mass Index (BMI) was calculated using WHO (1998) classification guidelines. The dietary pattern was evaluated using a detailed food frequency questionnaire that captured the weekly and daily consumption of 17 major food groups. Responses were categorized into frequency bins (e.g., never, 1–7 days/week) to quantify intake trends.

All anthropometric data were collected using calibrated equipment and standardized techniques to minimize observer variability. The study maintained strict adherence to ethical research practices. Written informed consent was obtained from each participant after providing a full explanation of the study's aims and procedures. Confidentiality and the right to withdraw at any stage were assured. Ethical approval was obtained from the Institutional Review Board of Category A Hospital. Data were coded and entered into IBM SPSS Statistics version 25.0 for analysis. Descriptive statistics such as frequency, percentage, and mean were calculated for all relevant variables. Chi-square tests were used to examine associations between categorical variables such as gender, education level, occupation, and marital status in relation to the presence of nephrolithiasis. A p-value of ≤ 0.05 was considered statistically significant. Cross-tabulation was performed to observe trends across gender and BMI categories, and graphical representations were generated for clearer visualization of prevalence patterns across various demographic and nutritional parameters.

RESULTS

Out of a total of 200 patients diagnosed with nephrolithiasis, 116 (58%) were females and 84 (42%) were males, indicating a higher prevalence in females. The participants' ages ranged from 18 to 78 years, with the most affected group being 24–34 years, comprising 54 individuals (27%), followed by the 35–44 years group with 41 patients (20.5%). Combined, these two groups accounted for 47.5% of the study population. Additional age group distributions included 55–64 years (16.5%), 45–54 years (14.5%), 15–24 years (10.5%), 65–74 years (5.5%), and 75–84 years (5.5%). Body Mass Index (BMI) classification revealed that nephrolithiasis was most prevalent in the overweight category (BMI 25.0–29.9 kg/m²), accounting for 31.9% of the population. This was followed by Obese Class I (BMI 30.0–34.9 kg/m²) at 26.4%, Normal BMI at 15.5%, Extremely Obese at 14.2%, and Obese Class II at 12.1%. Among females, 34.5% were overweight and 28.6% fell under Obese Class I, whereas 29.3% of males were overweight and 24.1% were Obese Class I. Normal BMI was noted in 15.6% of females and 15.3% of males. The Extremely Obese category included 16.37% of females and 12.08% of males, while 14.7% of females and 9.5% of males were classified as Obese Class II. In terms of marital status, 175 (87.5%) patients were married, whereas 25 (12.5%) were unmarried. Educational background showed that 44 patients (22%) each were either illiterate or held a bachelor's degree. Intermediate-level education was reported by 42 participants (21%), matriculation by 25 (12.5%), master's degree by 18 (9%), primary education by 14 (7%), secondary education by 12 (6%), and only 1 patient (0.5%) was a chartered accountant.

Occupational analysis revealed that 52% of female patients were housewives, while the remaining were employed in various sectors. Among males, all except one were employed. Of these, 17% were entrepreneurs, and 15% each were laborers or employees in formal or informal sectors. Income distribution ranged from zero to 500,000 PKR per month. Nearly 50% of housewives had no earnings, while working males showed a broader range, with professionals like consultants and doctors reporting the highest earnings and laborers and factory workers the lowest. Dietary analysis, based on a structured questionnaire, highlighted food consumption patterns across 17 dietary categories. Vegetables were consumed daily by 70.5% of patients, and rice was also a daily staple for 33.5%. Red meat consumption varied: 70% of patients had it 1–2 times weekly, 25% consumed it 3–6 times weekly, 3% never consumed it, and 2% consumed it daily. White meat (chicken/fish) was consumed twice to thrice a week by 22% of participants, 4–5 times by 15.25%, and daily to six times a week by 11.5%. Notably, 12% of the patients never consumed white meat. Beans were consumed daily by 21.5%, and twice to thrice a week by 16%, while 5% did not consume beans at all. Consumption frequencies for other food items included daily intake of fruits by 44%, fruit juices by 36%, green tea by 53.5%, and black tea by 63.5%. Carbonated drinks were consumed 3–4 times a week by the majority, while snacks were used as meal substitutes by a smaller portion of the population. Ice cream, leavened bread, milk, eggs, and unleavened bread showed variable frequencies of intake.

Table 1: Demographics Summary

Variable	Frequency	Percentage (%)
Total Patients	200	100
Female	116	58
Male	84	42

Variable	Frequency	Percentage (%)
Most Affected Age Group	24-34 years (54 patients)	27%
Married	175	87.5
Unmarried	25	12.5

Table 2: BMI Distribution by Gender

BMI Category	Female (%)	Male (%)
Normal	15.6	15.3
Overweight	34.5	29.3
Obese Class I	28.6	24.1
Obese Class II	14.7	9.5
Extremely Obese	16.37	12.08

Table 3: Educational Background of Patients

Education Level	Frequency	Percentage (%)
Illiterate	44	22
Primary Pass	14	7
Secondary Pass	12	6
Matric	25	12.5
Intermediate	42	21
Bachelors	44	22
Masters	18	9
Chartered Accountant	1	0.5

Table 4: Red Meat and Vegetable Consumption Patterns

Consumption Frequency	Red Meat (%)	Vegetables (%)
Never	3	0
1-2 times/week	70	0
3-6 times/week	25	29.5
Daily	2	70.5

Table 5: Percentage % Of food Categories Consumed By Nephrolithiasis Patient In District Mardan

Food Categories	Never	A Day in a Week	2 Days in a Week	3 Days in a Week	4 Days in a Week	5 Days in a Week	6 Days in a Week	7 Days in a Week
Beans (Cooked)	5.00 %	4.00%	14.50%	17.50%	7.00%	9.00%	19.00%	24.00%
Black Tea	-	-	-	-	9.00%	10.50%	17.00%	63.50%
Carbonated Drinks	-	12.50%	21.00%	28.50%	11.50%	9.00%	-	17.50%
Chicken	16.00%	-	32.50%	-	6.00%	7.00%	22.50%	16.00%
Egg	17.00%	-	36.50%	21.00%	-	8.50%	3.00%	14.00%
Fish	8.00 %	11.50%	21.50%	34.00%	17.50%	-	6.00%	1.50%

Food Categories	Never	A Day in a Week	2 Days in a Week	3 Days in a Week	4 Days in a Week	5 Days in a Week	6 Days in a Week	7 Days in a Week
Fresh Fruit Juices	2.50 %	19.00%	11.00%	-	-	4.50%	27.00%	36.00%
Fruits	-	-	4.00%	3.50%	7.00%	6.00%	35.50%	44.00%
Green Tea	1.00 %	6.50%	-	-	9.00%	15.50%	14.50%	53.50%
Ice Cream	22.50 %	41.00%	17.50%	12.00%	6.00%	-	-	1.00%
Leavened Bread	9.00 %	-	-	-	7.50%	26.00%	34.50%	23.00%
Milk, Cream & Cheese	5.00 %	-	-	-	21.50%	36.50%	29.00%	8.00%
Red Meat	3.00 %	36.50%	33.50%	11.50%	5.50%	3.50%	4.50%	2.00%
Snacks as a meals substitute	35.50 %	31.00%	16.00%	4.50%	7.00%	4.00%	2.00%	-
Rice	1.50 %	3.50%	17.00%	11.00%	8.50%	14.50%	11.00%	33.50%
Unleavened Bread	-	-	6.50%	7.50%	14.00%	19.50%	18.00%	34.50%
Vegetable (Raw or Cooked)	-	-	-	-	-	14.00%	15.50%	70.50%

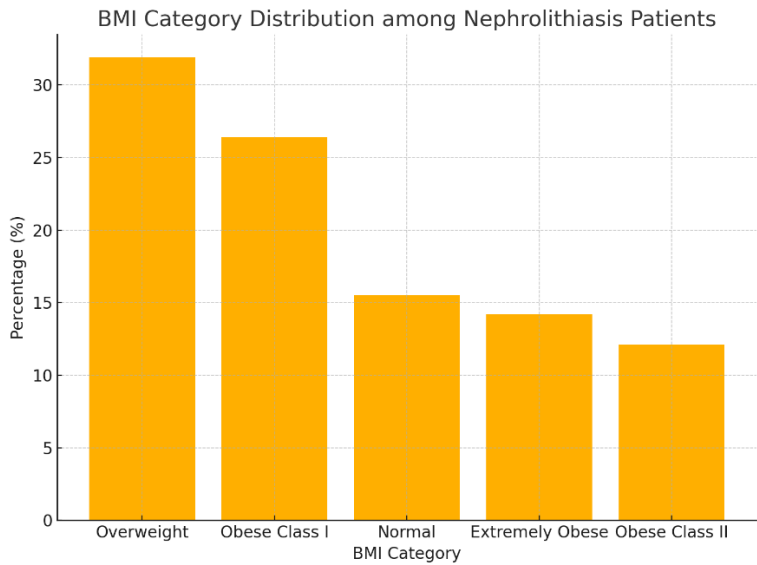


Figure 1 BMI Category Distribution among Nephrolithiasis Patients

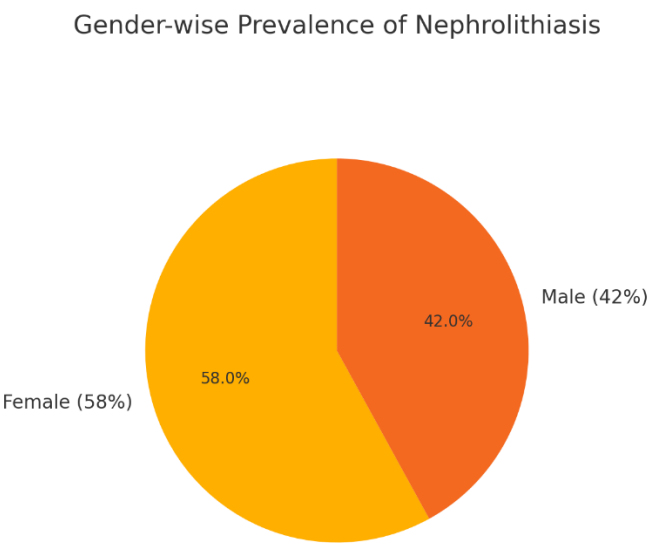


Figure 2 Gender-Wise Prevalence of Nephrolithiasis

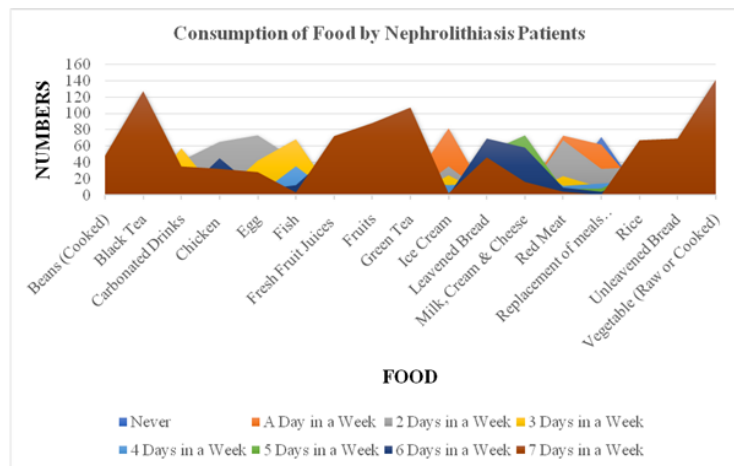


Figure 3 Consumption of Food by Nephrolithiasis Patients

DISCUSSION

The present study highlighted several demographic and nutritional factors contributing to the burden of nephrolithiasis in a regional Pakistani population, with findings that generally align with global and regional trends reported in prior literature. The mean age of the patients was 43 years with a standard deviation of 16.22, with the majority of cases observed in individuals aged 25 to 34 years. This age distribution is consistent with prior studies conducted on South Asian populations, where a significant proportion of nephrolithiasis cases clustered between the third and fourth decades of life (12). The female predominance observed in this study, with 58% of cases being female, further aligns with previous research suggesting an increasing incidence among women, potentially attributed to changing lifestyle, dietary patterns, and hormonal influences (13). One of the most prominent findings of the study was the high prevalence of overweight and obesity among nephrolithiasis patients. More than half of the participants fell into the overweight or Obese Class I categories. These findings reinforce earlier epidemiological observations indicating that higher body mass index is strongly associated with stone formation, particularly in populations with westernized diets or sedentary lifestyles (14). The implications are significant, as obesity not only promotes stone formation through altered urinary biochemistry but also contributes to stone recurrence and complicates management. Sociodemographic indicators further elaborated the risk landscape of nephrolithiasis in this cohort. A notable 87.5% of the participants were married, and a similar distribution pattern was observed in earlier regional studies, potentially reflecting marital lifestyle dynamics including shared dietary habits and physical activity patterns (15). Educational attainment among patients revealed that 68.5% of participants had attained intermediate education or lower, and 22% were illiterate. This trend supports previous conclusions that lower education levels are associated with higher nephrolithiasis risk, likely mediated through limited health awareness, poor dietary choices, and inadequate hydration practices (16).

The study further identified nephrolithiasis to be more prevalent in individuals from lower socioeconomic backgrounds. This is consistent with earlier investigations indicating that poor income status may restrict access to healthcare, clean water, and healthy nutrition, thus fostering a higher risk of stone formation (17,18). Among the employed individuals, laborers and factory workers constituted a considerable fraction of the cohort. Prior studies have indicated that occupations involving excessive heat exposure and physical exertion can promote dehydration, thereby increasing the risk of kidney stone formation through elevated urine concentration and osmolality (19). In the current study, 8.5% of the participants were laborers and factory workers, a subset likely exposed to high environmental temperatures and physical stress. Hydration status and dietary patterns played a significant role in the lifestyle profile of the patients. All participants reported some level of carbonated beverage consumption, a factor previously associated with increased lithogenic risk due to their high fructose and phosphate content (20). Additionally, 70.5% of participants were consuming oxalate-rich foods, including vegetables, cereals, fruits, and spices on a daily basis. This intake pattern, while nutritionally beneficial in other contexts, contributes to oxalate load in susceptible individuals and is a known risk factor for calcium oxalate stone formation (21). The dietary habits reported are suggestive of high oxalate, protein, and purine consumption, particularly from red and white meats, further compounding the risk profile for stone disease.

Despite offering valuable insights, the study had several limitations. Biochemical analysis including urinary oxalate, citrate, uric acid, calcium, and serum markers were not assessed, which limits the mechanistic interpretation of dietary and clinical findings. Additionally,

fluid intake was not quantitatively measured, even though hydration status is a critical determinant of stone formation. The use of a single-center sample and non-probability sampling limits the generalizability of the findings to the broader population. However, the study is strengthened by its comprehensive dietary assessment and robust demographic analysis, which allow for targeted public health recommendations in high-prevalence regions. Future research should incorporate prospective designs with biochemical validations, standardized dietary intake tracking, and hydration monitoring to refine risk stratification and intervention strategies. Multicenter studies are warranted to enhance external validity and explore genetic predispositions that may interact with lifestyle factors to influence stone pathogenesis. Overall, this study underscores the need for integrated nephrolithiasis prevention programs focusing on nutrition education, weight management, occupational health, and hydration, particularly in socioeconomically disadvantaged populations.

CONCLUSION

This study concluded that nephrolithiasis is influenced by gender, body mass index, and dietary patterns, with overweight and dietary habits emerging as notable contributing factors. The findings underscore the importance of structured dietary management and lifestyle modifications in reducing the risk and recurrence of kidney stones. Patients must be guided to limit the intake of stone-promoting foods and beverages, while increasing their fluid consumption through water and natural juices. Nutritional counseling and public awareness about the risk factors associated with nephrolithiasis are essential to mitigate its growing burden. The study emphasizes the critical role of prevention through education, balanced nutrition, and healthy living practices.

AUTHOR CONTRIBUTION

Author	Contribution
Uroosa Amjad	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Aleena Anees	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Jawad khan	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Nayab Ali	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Mian Mubeen Mansha	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Kiran Zubair	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Ayesha Bibi*	Contributed to study concept and Data collection Has given Final Approval of the version to be published

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