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Original research article

A case-control study on risk factors for renal stones in a tribal area of Nashik, India

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ABSTRACT

Introduction: Maharashtra, Gujarat, Punjab, Rajasthan, Delhi and Haryana are referred to as stone belt of India. Urolithiasis has been attributed to lifestyle, diet, animal protein, hot climate, low water intake, common systemic conditions and overweight or obesity, alcohol consumption and smoking. Regular drinking of tea, renal stone history, and stress at work are other risk factors of kidney calculi. This study aimed to identify risk factors and to see the strength of association between these risk factors and renal stone.

Materials and Methods: This study was hospital-based case control study carried out among 65 subjects in each group. Recently diagnosed (by ultrasonography) and admitted patients of renal stone aged between 20 to70 years were used as cases. All subjects were administered with questionnaire and were examined for body composition and their BMI and Waist to hip ratio were also calculated.

Results: BMI showed statistically significant higher values among renal stone patients than in controls. A significant association was observed between history of co-morbidities, addiction and renal stone. It was found that chances of development of renal stone among cases are 1.88 times more among the patients who are taking mixed diet. Also, consumption of milk, tea and history of processed food consumption were strongly associated renal stone. Consumption of unfiltered drinking water was also associated with development of renal stone.

Conclusion: Obesity, mixed diet, consumption of unfiltered water, consumption of milk and tea, processed food consumption, comorbidities and addictions are the predisposing factors for an increased risk of renal stones.

Keywords: Renal stone, obesity, processed food, water, milk, tea

INTRODUCTION

Renal stone disease is a common disorder and a significant health problem because of incidence, recurrence, and various complications [1]. The crystalline components of calcium oxalate and calcium phosphate make up at least 80% of all kidneys stones where as infection-induced and uric acid stones occur in 10% and 8%, respectively [2].

Renal stone affects all geographical regions across the globe. The Annual Global approximate prevalence is 3-5% and approximate life time prevalence is 15-25% with variation of 8-15% for the west and 20% Middle East countries such as Saudi Arabia. Recurrence rates of renal stone are approximately 10% year, 50% over a period of 5-10 years and 75% over 20 years' period [3, 4].

In India, approximately 2 million people affected with renal stone every year and some part of country is referred to be a stone belt which includes Maharashtra, Gujrat, Punjab, Rajasthan, Delhi and Haryana. A lifetime risk of 2% to 5% has been noted for development of renal stone in India [4, 5].

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 main reason for renal stone formation is super saturation of urine caused by various reasons age, sex, climate, diet, fluid intake, inheritance etc.[6]

The untreated and recurrent renal stone often leads to development of serious complications such as diminished renal function, urinary fistula formation, ureteral scarring and stenos is, urethral perforation, extravasations, urosepsis and renal failure. Acute renal colic is associated with a unique set of complications during pregnancy [7, 8].

Nephrolithiasis is associated with a high cost to society because of high prevalence of the disease and high rates of recurrence. In India, the cost for treatment is ranging from Rs. 25,000 to 90,000 depending on size, location and number of stone. Also, it depends on general cost of hospital, expertise of surgeon,

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type of procedures and severity of conditions.
Urolithiasis occurrence has been attributed to lifestyle, diet, animal protein, hot climate, low water intake, common systemic conditions and overweight or obesity, alcohol consumption and smoking. Some other factors include age, gender, race, diuretic use, low fluid intake, and low urine volume. Regular drinking of tea, renal stone history, and stress at work are other risk factors of kidney calculi. [9]
This study aimed to identify risk factors and to see the strength of association between these risk factors and renal stone.

MATERIALS AND METHODS

This study was hospital-based case control study carried out among OPD patients using systematic random sampling procedure. The sample size was calculated with assumptions, odds ratio=2.47 for renal stone; with power at 80%, 5% of alpha error, case-control ratio 1:1, percentage of exposure among control 50%, the minimum sample size to test the hypothesis was found to be 65 using the formula. So, we included 65 subjects in each group.
Recently diagnosed (by ultrasonography) and admitted patients of renal stone aged between 20 to70 years were the criterion used for selection of cases. Appropriately matched hospital-based controls aged between 20 to 70 years were selected after ruling out renal stone by asking them past history and confirmed by ultrasonography.
Cases of carcinoma, chronic infections, endocrine disorder, and nonresidents of tribal area of North Maharashtra were excluded from both the cases and controls. Renal stones with acute complication such as renal colic and patients having past history of surgery done for renal stone were excluded from cases.
The study protocol was approved by the scientific research committee and Institutional Ethical Committee.
After taking written informed consents, the recently diagnosed patients of renal stone were administered with questionnaire. Their details such as demographic, socioeconomic, diet pattern, fluid intake and dietary life style habits were noted. They were examined for body composition and their BMI and Waist to hip ration were also calculated. The controls that were not found to be having renal stones also underwent the same procedure as cases.

RESULTS

The mean age of both cases and controls were 45.70 ± 8.22 years and 48.06 ± 12.32 years. Both cases and controls are comparable to each other's in respect to age, sex, socio-economic and education status as there was not statistically significant difference observed (P Value > 0.05). As depicted in table no. 1, most patients of both cases and controls (Approx. 60%) were educated till secondary school. Most of cases (69%) and controls (63%) were belong to either lower middle to Middle class. Also on further enquiry, most of cases and controls were having either orange (69%) or yellow (31%) type of ration card.
As shown in table no. 2, Anthropometrical parameter like BMI showed statistically significant higher values among renal stone patients than in controls (p value <0.05, OR= 2.59) but similar significant association was not seen with WHR (P value >0.05, OR=1.20).
The parameters like history of associated co-morbidities and addiction were strongly associated with renal stone. It was seen that there was strong association between history of co-morbidities (Specially Diabetes and hypertension) and history of cases (History of co-Morbidities-p value <0.05 OR= 2.27). Similar association was also found out between addiction and history of renal stone (Addiction-p value < 0.05, OR= 2.25).
As depicted in table no. 3, it was found that chances of development of renal stone among cases are 1.88 times more among the patients who are taking mixed diet when compared to the patients who are taking strict Vegetarian diet. The chance of development of renal stone is strongly associated with consumption of Milk (OR= 1.36), Tea (OR=3.375and history of processed food consumption including intake of condensed sugary food items (OR = 5.33).

Table 1: Socio-demographic details of study participants

Variable	Cases	Control	OR/Chi-square Value	95% CI		P-value*
Age Groups				LCL	UCL	
<40	15(23.08%)	17(26.15%)	0.8471	0.3809	1.8839	0.6839
≥ 40	50(76.92%)	48(73.85%)				
Sex	Case	Control	0.5752	0.2617	1.264	0.1663
Female	14(21.54%)	21(32.31%)				
Male	51(78.46%)	44(67.69%)				
Socio economic class^				NA	NA	0.3554

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I	3(4.62%)	1(1.54%)	4.3931**			
II	21(32.31%)	20(30.77%)				
III	21(32.31%)	23(35.38%)				
IV	18(27.69%)	14(21.54%)				
V	2(3.08%)	7(10.77%)				
Education						
Graduate	5(7.69%)	7(11.11%)				
Higher Secondary	14(21.54%)	11(17.46%)				
Illiterate	2(3.08%)	6(9.52%)				
Post Graduate	2(3.08%)	1(1.59%)	5.511**	NA	NA	0.3567
Primary	3(4.62%)	7(11.11%)				
Secondary	39(60.00%)	31(49.31%)				
TOTAL	65(100.0%)	65(100.0%)				

(^ Modified BJ Prasad Classification, *Chi-square test applied, OR= Odds Ratio**Chi-square Value)

Table 2: Morbidity and Anthropometrical details of study participants

Variables		**Cases**	**Control**	**OR**	**95% Confidence interval (LCLUCL)**		**P-value****
H/O of Co-morbidities	Yes	40(61.54%)	26(41.27%)	2.2769	1.1217	4.6221	0.0217
	No	25(38.46%)	37(58.73%)				
H/O of Addiction	Yes	37(56.92%)	24(36.92%)	2.2574	1.1172	4.5615	0.022
	No	28(43.08%)	41(63.08%)				
BMI	Overweight & Obese	51(78.46%)	38(58.46%)	2.59	1.21	5.55	0.019*
	Normal	14(21.54%)	27(41.54%				
WHR	High	29(44.62%)	26(40.00%)	1.2083	0.602	2.4253	0.5943
	Normal	36(55.38%)	39(60.00%)				
	Total	65(100.0%)	65(100.0%)				

(*Fisher exact test applied, **Chi-square test applied, OR= Odds Ratio)

Table 3: Categorical variables associated with renal stone

Variables		**Case**	**Control**	**OR/Chi-square value**	**LCL**	**UCL**	**P-value****
Diet Type	Mixed	26 (40.0%)	17 (26.15%)	1.8824	0.8953	3.9577	0.0934
	Veg	39 (60.0%)	48 (73.85%)				
Source of Drinking water	Tapped	36 (55.38%)	45 (69.23%)	0.5517	0.2689	1.1321	0.1034
	Well	29 (44.62%)	20 (30.77%)				
Type of drinking water	Filtered	28 (43.08%)	43 (66.15%)	0.3872	0.1902	0.788	0.0082
	Unfiltered	37 (56.92%)	22 (33.85%)				
Type of Milk	Buffalo	34 (52.31%)	29 (44.62%)	1.3615	0.6829	2.7145	0.3802
	Cow	31 (47.69%)	36 (55.38%)				
H/O consumption of tea	Yes	39 (60.00%)	20 (30.77%)	3.375	1.6368	6.9592	0.0008
	No	26 (40.00%)	45 (69.23%)				
How many cups/Days?	More than 5 cups	26 (40.00%)	15 (23.08%)	11.5913*	NA	NA	0.003
	Less than 5 cups	13 (20.00%)	5 (7.69%)				
	Not having Tea	26 (40.00%)	45 (69.3%)				
H/O processed foods Consumption (Including highly condensed	Yes	5 (7.69%)	1 (1.54%)	5.333	0.6054	46.9811	0.0945
	No	60 (92.31%)	64 (98.46%)				

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sugar)							
Total		65 (100%)	65 (100%)				

(*Chi square Value, **Chi square test applied, OR= Odds Ratio)

DISCUSSION

A hospital-based case control study was carried out to identify the risk factors of renal stones in tribal area of Nashik, Maharashtra, India. Contrary to the results of previous studies, we found no significant association of age and gender with kidney stone formation in this study [10, 11, 12]. This difference can be due to variation in the age, gender, ethnicity, sample size, environmental and other factors in these studies.

BMI was found to be significantly associated with renal stones but no such association was found between WHR and renal stones. Similar results were reported by previous studies [13, 14]. However, Zhao *et al*. [10] found that hypso-WHR was positively associated with Nephrolithiasis. The underlying Pathophysiology of stone formation in obese patients is thought to be related to insulin resistance, dietary factors, and a Lithogenic urinary profile. Uric acid stones and calcium oxalate stones are observed frequently in these patients. Insulin resistance is thought to alter the renal acid-base metabolism, resulting in a lower urine pH and increasing the risk of uric acid stone disease. Obesity is also associated with excess nutritional intake of Lithogenic substances and with an increase in urinary tract infection incidence [15].

We found that Nephrolithiasis was significantly associated with consumption of unfiltered water. However, the water source whether from well or tapped water was not associated with increased chances of renal stones. Similarly, Dongre an R *et al*. [16] and Ramello A *et al*. [17] did not find any association between kidney stone and tap water hardness. Hence, an effort to educate patient and community to eliminate this misconception would be required.

The higher calcium content of milk and oxalate content of tea is frequently associated with Nephrolithiasis. The development of renal stonewas strongly associated with consumption of milk; tea, amount of tea consumed per day, and processed food consumption. However, we did not find association between vegetarian diet and mixed diet with renal stones. Similar results were reported by Kunjumon M K *et al*. [12] but Dongre AR *et al*.[16] found a positive correlation between red meat consumption and renal stones.

In our study, history of comorbidities (especially diabetes and hypertension) was significantly associated with renal stones. Similarly, history of addictions was significantly associated with renal stones in our study. Similar results were reported by Khalili P *et al*. [18].

Even though Urolithiasis is caused by several factors, it will be different from one geographical area to other. Patients, family and communities should be educated about the occurrence of disease and related risk factors and has to be followed in their daily life.

CONCLUSIONS

Obesity, mixed diet, consumption of unfiltered water, consumption of milk and tea, processed food consumption, comorbidities and addictions are the predisposing factors for an increased risk of renal stones in tribal area of Nashik, India. Patients, family and communities should be educated about these risk factors to reduce renal stone incidence.

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