e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2023; 15(10); 686-691

Original Research Article

To Investigate the Prevalence of Risk Factors of Kidney Stones: An Observational Study

Rakesh Kumar[1], Archana Sinha[2], Purushottam Kumar[3]

[1]Assistant Professor, Department of Urology, AIIMS, Patna, Bihar, India

[2]Medical Officer, Department of Microbiology, BMIMS, Pawapuri, Nalanda, Bihar, India

[3]Assistant Professor, Department of Medicine, BMIMS, Pawapuri, Nalanda, Bihar, India

Received: 10-07-2023 Revised: 19-08-2023 / Accepted: 23-09-2023
Corresponding Author: Dr. Archana Sinha
Conflict of interest: Nil

Abstract

Aim: The aim of the present study was to investigate the prevalence of risk factors of kidney stones.

Methods: The present study was conducted in the Department of Urology and we recruited a total of 200 participants of both genders aged 35–70 years.

Results: We compared the distribution of lifestyle- related variables, as well as, history of diabetes and high blood pressure between the two groups. The prevalence of kidney stone was associated with alcohol drinking and smoking. Moreover, kidney stone was more prevalent in the people with middle-high WSI, high BMI, and with a history of diabetes and blood pressure. Majority of the case group (people with kidney stone) was male and had significantly higher alcohol consumption and middle to higher WSI in comparison to the control group (people without kidney stone). Consumption of purified drinking water was considerably lower in the case group compared with the control group. In addition, the cases were more likely to have a high BMI, history of diabetes and high blood pressure compared with the study controls. The related factors associated with kidney stone in Univariate analysis were also assessed and the subjects with kidney stone were compared with the normal subjects. The odds of having kidney stone were estimated for twelve factors: gender, age, education level, WSI, cigarette smoking, alcohol drinking, opium consumption, hookah smoking, BMI, consumption of purified water in lifetime, and history of chronic disease (diabetes and hypertension). It was found that all of these factors with the exception of cigarette smoking were significantly associated with kidney stone in the Univariate analysis.

Conclusion: According to the results of the present study, factors such as gender, hypertension, obesity, diabetes and personal habits like alcohol consumption and cigarette smoking are related with the development of kidney stones. So, by identifying the susceptible patients and teaching them, the burden of the disease on society and the individual can be reduced.

Keywords: Kidney stone, Risk factors

Introduction

Around 1% of emergency admissions are caused by renal colic and complications of renal stones. [1] Kidney stones are common across the world, with a prevalence of about 12% worldwide. [2] Their prevalence in India also reflects worldwide prevalence and stands at approximately 12% and is relatively more common in the northern part of India, where it is 15%. [1,3] The origin of kidney stones is considered multifactorial, being affected by age, gender, family history, diet, comorbidities, environment, genetic inheritance, and other factors. There are high chances of recurrence of kidney stones irrespective of treatment. It is seen that approximately 98% of patients will develop another stone within 25 years of the first episode. [1] The calcium oxalate variety of renal stones is the most common, constituting 60% of all these stones. [4]

It has been seen that genetic polymorphism of vitamin D receptor (VDR), Klotho, and chloride voltage-gated channels (CLCN) genes have a role in the formation of kidney stones. VDR is a polymorphic gene having a role in mineral metabolism. It increases the absorption of calcium and excretion of citrate. Studies reveal that multiple allelic variations in VDR, like ApaI, BsmI, TaqI, and Fok1, are associated with nephrolithiasis. VDR Fok1 is a thymine/cytosine polymorphism located at the start (ATG) codon on the 5' end of VDR, which also showed a role in the formation of renal stones. [5] Nephrolithiasis, more commonly known as kidney stones, is a prevailing health issue of

significant concern affecting millions of people globally. [6] With its pervasive reach, the occurrence and characteristics of nephrolithiasis display noticeable variations across distinct geographic regions and populations. These disparities are observed not just in incidence rates but also extend to more intricate features like stone composition.

For instance, a noteworthy difference is observed between developed and developing countries, where calcium-containing stones tend to be more prevalent in developed nations. [7] Such contrasts can likely be attributed to differences in dietary habits, driven by socioeconomic factors, access to specific food groups, cultural preferences, and other local conditions. Consequently, understanding these regional variations and associated risk factors can provide valuable insights into the underlying pathophysiology of nephrolithiasis. This knowledge could potentially guide the development of region-specific preventive measures and treatment strategies, thereby enhancing the effectiveness of interventions. [6]

Several international studies have embarked on the journey to identify and understand the complex landscape of risk factors contributing to nephrolithiasis formation. A consensus has been reached to categorize the significant risk factors into four primary domains: dietary, genetic, environmental, and lifestyle. These categories encompass a multitude of specific elements including age, sex, race, daily habits, genetic predispositions, smoking habits, and various environmental exposures. [8,9]

The aim of the present study was to investigate the prevalence of risk factors of kidney stones.

Materials and Methods

The present study was conducted in the Department of Urology, AIIMS, Patna, Bihar, India for one year and we recruited a total of 200 participants of both genders aged 35–70 years. Those who had incomplete medical questionnaire met our exclusion criterion and so were excluded. The following inclusion criteria were considered in the selection of the population: (1) inclusion of areas with minimum migration rates in order to limit loss to follow-up rate (2) inclusion of populations with different socio-economic levels, as well as environmental and occupational exposures.

Outcome Assessment

Expert interviewers interviewed each participant and completed the related questionnaires about his/her socioeconomic status, demography, occupational status, personal habits, history of disease, biochemical tests, blood pressure, physical activity and body mass index (BMI). All of the questionnaires were previously validated.

Based on the self-administered questionnaire, kidney stone, hypertension and diabetes was identified and included in the history of diseases if the disease was previously diagnosed by a doctor. Also, the expert interviewers asked questions about the signs of the diseases and the treatments used was overweight and obesity, intake of purified water, habits and lifestyle were also self-reported by the participants. Education level was coded as (1) Illiterate, (2) Elementary, (3) Guidance school and Diploma, (4) College education. [10] It is noteworthy that the informed consent was obtained from the legal guardians of the illiterate participants.

The daily physical activity of the participants was weighted based on its relative metabolic cost, known as a metabolic equivalent (MET), and MET-h/day for 24 h is derived in this way. [11,12] Data on the personal habit including cigarette and hookah smoking, alcohol drinking, and opium consumption were coded as yes (currently or formerly) and no (never).[10] The wealth score index (WSI) was classified into four categories: low income (1st quartile: ≤ -0.6069), low- middle income (2nd quartile: -0.607 to 0.0349), middle-high income (3rd quartile: 0.035 to 1.169) and high income (4th quartile: ≥ 1.170). [11] The source of drinking water was also questioned; whether purified water was consumed or not. [10]

Statistical Analyses

Related factors for kidney stones including sociodemographic characteristics, life style and history of chronic disease were identified using relevant epidemiological texts and based on subject matter knowledge. For describing the distribution of the data, the frequency (percentage) of the categorical variables and the mean ± standard deviation of the quantitative variables were reported and their distribution among the case and control groups were compared using chi-square and independent t-test tests, respectively. The strength of the association between histories of kidney stones and relevant related factors was evaluated using odds ratios (ORs) and confidence intervals (CIs). We used univariable and multivariable logistics regression analyses to estimate odds ratios with 95% confidence intervals.

Results

Table 1: Baseline characteristics

Characteristics	Total	Kidney stone N=50	No kidney stone N=150
Age——years (Mean ±SD)	48.92 ±8.52	50.04 ±9.41	48.52 ±9.51
Age—no. (%)			
35–44	70	15	55
45–54	60	15	45
55–64	55	15	40
≥65	15	5	10
Gender—no. (%)			
Female	110	25	85
Male	90	25	65
Education—no. (%)			
Illiterate	20	5	15
Elementary	50	13	37
Guidance school and Diploma	96	23	46
College	34	8	26
Physical activity (mean ± SD)	38.79 ±6.32	38.85 ±6.30	38.77 ±6.33
Alcohol consumption—no. (%)			
Yes	30	8	22
No	170	42	128
Cigarette smoking—no. (%)			
Yes	50	12	37
No	150	36	114
Drinking of purified water in lifetime—no. (%)			
Yes	96	22	74
No	104	28	76
Hypertension—no. (%)			
Yes	45	14	31
No	155	35	120
BMI—no. (%)			
<25	55	12	43
25–29.9	80	22	58
≥30	65	15	50
Diabetes mellitus—no. (%)			
Yes	40	12	28
No	160	37	123
WSI—no. (%)			
Low	55	12	43
Low‐middle	48	13	35
Middle‐high	60	15	45
High	37	9	26

We compared the distribution of lifestyle- related variables, as well as, history of diabetes and high blood pressure between the two groups. The prevalence of kidney stone was associated with alcohol drinking and smoking. Moreover, kidney stone was more prevalent in the people with middle-high WSI, high BMI, and with a history of diabetes and blood pressure. Majority of the case group (people with kidney stone) was male and had significantly higher alcohol consumption and middle to higher WSI in comparison to the control group (people without kidney stone). Consumption of purified drinking water was considerably lower in the case group com- pared with the control group. In addition, the cases were more likely to have a high BMI, history of diabetes and high blood pressure compared with the study controls.

Table 2: Patient factors and the odds of having kidney stone

Patient factors	Univariable	Multivariable OR (95% CI)
Age—year		
35–44	1	1
45–54	1.19 (1.04–1.32)	1.05 (0.92–1.19)
55–64	1.36 (1.21–1.54)	1.12 (0.95–1.28)
≥ 65	1.52 (1.26–1.82)	1.16 (0.93–1.42)
Gender		
Female	1	1
Male	1.36 (1.26–1.52)	1.54 (1.39–1.76)
Alcohol consumption		
No	1	1
Yes	1.20 (1.03–1.34)	1.14 (0.96–1.31)
Cigarette smoking		
No	1	1
Yes	1.07 (0.94–1.16)	0.82 (0.70–0.93)
Drinking of purified water in lifetime		
Yes	1	1
No	1.34 (1.21–1.46)	1.22 (1.08–1.35)
Hypertension		
No	1	1
Yes	1.47 (1.33–1.64)	1.32 (1.18–1.50)
BMI		
< 25	1	1
25–29.9	1.25 (1.11–1.40)	1.25 (1.11–1.40)
≥ 30	1.25 (1.11–1.41)	1.30 (1.14–1.48)
Diabetes mellitus		
No	1	1
Yes	1.46 (1.29–1.61)	1.24 (1.12–1.43)
WSI		
Low	1	1
Low‑middle	1.17 (1.02–1.32)	1.13 (1.01–1.30)
Middle‑high	1.24 (1.09–1.40)	1.25 (1.10–1.42)
High	1.08 (0.95–1.25)	1.08 (0.94–1.25)

The related factors associated with kidney stone in Univariate analysis were also assessed and the subjects with kidney stone were compared with the normal subjects. The odds of having kidney stone were estimated for twelve factors: gender, age, education level, WSI, cigarette smoking, alcohol drinking, opium consumption, hookah smoking, BMI, consumption of purified water in lifetime, and history of chronic disease (diabetes and hypertension). It was found that all of these factors with the exception of cigarette smoking were significantly associated with kidney stone in the Univariate analysis.

Discussion

The prevalence and incidence of kidney stones is rising worldwide. [13] Kidney stones are hard deposits of minerals (calcium, oxalate and phosphate) which are formed from dissolved minerals in the urine and are usually excreted in the urethra. [14] Kidney stones are the third most common urinary tract problem after urinary tract infections and prostate disorders. [15] Kidney stones are classified into calcium oxalate, calcium phosphate, uric acid, cysteine, struvite, and depending on the material of the stones. Calcium stones account for almost 70–80% of all kidney stones. [16]

Known risk factors for urolithiasis include intrinsic factors (such as age, gender, race, and family history) and extrinsic factors (such as dietary practices, water intake, and geographic location). In accordance with the findings of Santanapipatkul et al. [17] Family history is a combination of both internal and external factors, as family history may arise from both genetic predispositions, while it may also arise from similar dietary intake and water sources. [18] We compared the distribution of lifestyle- related variables, as well as, history of

diabetes and high blood pressure between the two groups. The prevalence of kidney stone was associated with alcohol drinking and smoking. Moreover, kidney stone was more prevalent in the people with middle-high WSI, high BMI, and with a history of diabetes and blood pressure. Majority of the case group (people with kidney stone) was male and had significantly higher alcohol consumption and middle to higher WSI in comparison to the control group (people without kidney stone). Consumption of purified drinking water was considerably lower in the case group com- pared with the control group. In addition, the cases were more likely to have a high BMI, history of diabetes and high blood pressure compared with the study controls. Sofia NH et al [14] showed that the proportion of smokers in nephrolithiasis patients was significantly higher than normal subjects. The relation between cigarette smoking and the formation of kidney stone may be explained by the high levels of cadmium and lead in smokers' body. Cigarette smoking may result in the induction of urolithiasis by reducing urinary flow and increasing the concentration of serum cadmium. However, these associations were examined in the adjusted model and the obtained results showed that there was no association between cigarette smoking, alcohol consumption and opium use with kidney stones after adjusting for other related factors. According to the results, cases were more likely to have a high WSI and BMI, history of diabetes and high blood pressure compared with the study controls. Even after adjustment for potential confounders, we found that high WSI and BMI, as well as, history of diabetes and high blood pressure increased odds of kidney stones. Similarly, Taylor et al [19] reported a positive correlation of the risk of kidney stones development with BMI and waist circumference (WC). Also, Nowfar et al [20] found that the incidence of nephrolithiasis was directly associated with obesity in both genders.

The related factors associated with kidney stone in Univariate analysis were also assessed and the subjects with kidney stone were compared with the normal subjects. The odds of having kidney stone were estimated for twelve factors: gender, age, education level, WSI, cigarette smoking, alcohol drinking, opium consumption, hookah smoking, BMI, consumption of purified water in lifetime, and history of chronic disease (diabetes and hypertension). It was found that all of these factors with the exception of cigarette smoking were significantly associated with kidney stone in the Univariate analysis. Based on the results of our study, odds of consumption of purified water in the case group was lower in comparison to the control group, and this parameter was a significantly association of kidney stone. In this regard and in contrast to our results, the results of a study by Basiri et al [21] on various capitals of Iran showed that the total hardness of tap water was not significantly associated with the regional prevalence of urinary calculus. Also, Pubali et al [22] reported no considerable association between water quality and the occurrence of kidney stones. Similarly our results, the results of the studies by Barkers and Donnan [23] and Churchill et al [24] demonstrated a positive association between urinary calculus and the total hardness of drinking water.

Conclusion

According to the results of the present study, factors such as gender, hypertension, obesity, diabetes and personal habits like alcohol consumption and cigarette smoking are related with the development of kidney stones. So, by identifying the susceptible patients and teaching them, the burden of the disease on society and the individual can be reduced. The results of this study are helpful to health care providers for preventive planning for kidney stone disease.

References

1. Kakkar M, Kakkar R. A 13 year hospital based study on the trend of urinary stone disease in Uttarakhand, India. Nepal Journal of Epidem-iology. 2021 Mar;11(1):949.
2. Nojaba L, Guzman N. Nephrolithiasis. StatPearls. Treasure Island (FL).
3. Guha M, Banerjee H, Mitra P, Das M. The demographic diversity of food intake and prevalence of kidney stone diseases in the Indian continent. Foods. 2019 Jan 21;8(1):37.
4. Shin S, Srivastava A, Alli NA, Bandyo-padhyay BC. Confounding risk factors and preventative measures driving nephrolithiasis global makeup. World Journal of Nephrology. 2018 Nov 11;7(7):129.
5. Government of NCT, Delhi. Guru Teg Bahadur Hospital, Delhi.
6. Ziemba JB, Matlaga BR. Epidemiology and economics of nephrolithiasis. Investigative and clinical urology. 2017 Sep;58(5):299-306.
7. Mayans L. Nephrolithiasis. Primary Care: Clinics in Office Practice. 2019 Jun 1;46(2): 203-12.
8. Jiang YG, He LH, Luo GT, Zhang XD. Prevalence of kidney stones and associated risk factors in the Shunyi District of Beijing, China. Hong Kong Medical Journal. 2017 Oct 1;23 (5):462.
9. Matsuba T, Chiba M, Akkhavong K, Sisuraj A, INABA Y. Risk factor of urolithiasis in Laos. Japanese Journal of Health and Human Ecology. 2005;71(6):255-62.
10. Hakimi H, Ahmadi J, Vakilian A, Jamalizadeh A, Kamyab Z, Mehran M, Malekzadeh R, Poustchi H, Eghtesad S, Sardari F, Soleimani M. The profile of Rafsanjan cohort study.

European Journal of Epidemiology. 2021 Feb; 36:243-52.
11. Eghtesad S, Mohammadi Z, Shayanrad A, Faramarzi E, Joukar F, Hamzeh B, Farjam M, Sakhvidi MJ, Miri-Monjar M, Moosazadeh M, Hakimi H. The PERSIAN cohort: providing the evidence needed for healthcare reform. Archives of Iranian medicine. 2017 Nov 1;20 (11):691-5.
12. Aguilar-Farias N, Brown WJ, Skinner TL, Peeters GG. Metabolic equivalent values of common daily activities in middle-age and older adults in free-living environments: a pilot study. J Phys Act Health. 2019 Mar 1;16(3): 2 22-9.
13. Romero V, Akpinar H, Assimos DG. Kidney stones: a global picture of prevalence, incidence, and associated risk factors. Rev Urol. 2010;12(2–3):e86.
14. Sofia NH, Walter TM, Sanatorium T. Prevalence and risk factors of kidney stone. Glob J Res Anal. 2016;5(3):183–7.
15. Delfan B, Baharvand-Ahmadi B, Bahmani M, Mohseni N, Saki K, Rafieian-Kopaei M, Shahsavari S, Naghdi N, Taherikalani M, Ghafourian S. An ethnobotanical study of medicinal plants used in treatment of kidney stones and kidney pain in Lorestan province, Iran. Journal of Chemical and Pharmaceutical Sciences. 2015;8(4):693-9.
16. Nikpay S, Moradi K, Azami M, Babashahi M, Otaghi M, Borji M. Frequency of kidney stone different compositions in patients referred to a Lithotripsy Center in Ilam, West of Iran. J Pediatr Nephrol. 2016;4(3):102–7.
17. Santanapipatkul K, Jantakun W, Tanthanuch M. Risk factors for urolithiasis in a Thai population. Thai J Urol. 2019;40(2):9–18.
18. Perumal KR, Chua RH, Teh GC, Lei CC. Prevalence of urolithiasis in Sarawak and associated risk factors: An ultrasonagraphy-based cross-sectional study. BJUI compass. 20 23 Jan;4(1):74-80.
19. Taylor EN, Stampfer MJ, Curhan GC. Obesity, weight gain, and the risk of kidney stones. JAMA. 2005;293(4):455–62.
20. Nowfar S, Palazzi-Churas K, Chang DC, Sur RL. The relationship of obesity and gender prevalence changes in United States inpatient nephrolithiasis. Urology. 2011;78(5):1029–33.
21. BASIRI A, SHAKH SN, KHOUSHDEL A, Pakmanesh H, Radfar MH. Drinking water composition and incidence of urinary calculus introducing a new index.
22. Mitra P, Pal DK, Das M. Does quality of drinking water matter in kidney stone disease: a study in West Bengal, India. Investig Clin Urol. 2018;59(3):158.
23. Barker D, Donnan S. Regional variations in the incidence of upper urinary tract stones in England and Wales. Br Med J. 1978;1(6105): 67–70.
24. Churchill D, Bryant D, Fodor G, Gault MH. Drinking water hardness and urolithiasis. Ann Intern Med. 1978;88(4):513–4.