



PREVALENCE AND RISK FACTORS OF KIDNEY STONE

Nalini H.Sofia

Lecturer, Department of Maruthuvam (Medicine) National Institute of Siddha, Tambaram Sanatorium, Chennai, India.

Manickavasakam. K

Ex- Director, National Institute of Siddha, Tambaram Sanatorium, Chennai, India.

Thomas M.Walter

Lecturer, Department of Gunapadam (Pharmacology), Govt. Siddha Medical College, Palayamkottai, India.

ABSTRACT

Background: Kidney stone affect 10-12% of the population in industrialized countries. The average life time risk of stone formation has been reported in the range of 5-10%. Recurrent stone formation is a common part of the medical care of patients with stone diseases. The aetiology of this disorder is multi factorial and is strongly related to dietary lifestyle habits or practices. Increased rates of hypertension, diabetes and obesity which are linked to nephrolithiasis, also contribute to an increase in stone formation. Hence, this study was undertaken to find out the prevalence among kidney stone patients. Aim and objectives: To assess the prevalence of kidney stone among patients visiting in OPD-1, Dept. of Maruthuvam (Medicine), National Institute of Siddha and also to find out the risk factors influencing the development of kidney stones especially Family history, inadequate fluid intake, Stress, Over weight and Obesity, Dietary habits and lifestyle modifications, association with other diseases (diabetes, hypertension). Materials and methods: The study was conducted among 666 kalladaippu (kidney stone) patients. Details of factors influencing the formation of kidney stone were obtained using a pretested questionnaire. Results and conclusion: The study revealed a high prevalence of kidney stone is due to low fluid intake 72.07% (p=0.000), dehydration 67.56% (p=0.012) and dietary habits of mixed diet 91.59% (p=0.000), high intake of coffee and tea 57.50%, sodium 64.26%, sugar 49.84%. Life style modifications of smoking 36.03%, alcohol consumption 41.59%, lack of physical activity 42.79%, obesity 54.80% also revealed a high prevalence of this disease.

KEYWORDS : Kalladaippu, Kidney stone, risk factors, Siddha.

INTRODUCTION

Kidney stones, one of the most painful of the urologic disorders, are not a product of modern life. Unfortunately, kidney stones are one of the most common disorders of the urinary tract. A large number of people are suffering from urinary stone problem all over the globe. Kidney stones, which are solid crystals that form from dissolved minerals in urine, can be caused by both environmental and metabolic problems. Calcium oxalate and/or phosphate stones account for almost 70% of all renal stones observed in economically developed countries.

Kidney stones are quite common and usually affect people who are between 30 and 60 years of age. They affect men more than women. It is estimated that renal colic (severe pain caused by a kidney stone) affects about 10-20% of men, and 3-5% of women. In India, 12% of the population is expected to have urinary stones, out of which 50% may end up with loss of kidneys or renal damage. Recurrent stone formation is a common problem with all types of stones and therefore an important part of the medical care of patients with stone disease.

In most countries with a relatively high incidence of renal calculi due to climate, diet habits, local geology with hydro mineralogy and sanitation by affecting geo mineralogy. Rising global temperatures could lead to an increase in kidney stones, according to research presented at the 103rd Annual Scientific Meeting of the American Urological Association (AUA). Dehydration has been linked to stone disease, particularly in warmer climates, and global warming will exacerbate this effect. The correlation between increased environmental temperature and increased number of stone events supports the conclusion that global warming has an impact on the development of stones. This has been recently addressed in a study by Brikowski and associates. As a result, the prevalence of stone disease may increase, along with the costs of treating the condition. The researchers discovered that stone formers had a 60% greater risk of developing chronic kidney disease (CKD) and a 40% increased risk of developing end-stage renal disease (ESRD), the most severe form of CKD.

Diet may have a significant impact on the incidence of urinary stones. The incidence has been steadily increasing, paralleling the rise in other diseases associated with the so called 'Western diet'. Being obese (higher BMI) and experiencing weight gain have been associated with stone risk among men and women. Diet and fluid intake may be important factors in the development of urinary stones. As per capita income increases, the average diet changes, with an increase in saturated and unsaturated fatty acid; an increase in animal protein and sugar; and a decrease in dietary fibre, vegetable protein and unrefined carbohydrates. Increased animal protein intake, lower potassium intake, lower fluid intake were recently identified to higher stone risk.

Higher consumption of fructose has been tied to kidney stone risk. A less energy dense diet may decrease the incidence of stones. This fact has been documented during war years when diets containing minimal fat and protein resulted in a decreased incidence of urinary stones. Those afflicted with recurrent urinary stone disease are encouraged to maintain a diet restricted in sodium and protein intake. [Postmenopausal](#) women with low [estrogen](#) levels have an increased risk for kidney stones. Women who have had their ovaries removed are also at increased risk.

AIM AND OBJECTIVES

The objective of this study was to evaluate the prevalence of kalladaippu (Renal calculi) among patients visiting in OPD-1, Dept. of Maruthuvam (Medicine), National Institute of Siddha and to assess the factors influencing the development of kidney stones and also to find out the independent relationship of the following risk factors especially Family history, inadequate fluid intake, Stress, Over weight and Obesity, Dietary habits and association with lifestyle modifications.

MATERIALS AND METHODS

Six hundred and sixty six (666) patients visited OPD-1, Dept. of Maruthuvam (Medicine), National Institute of Siddha for the treatment of kalladaippu during the period between November 2013 and October 2014 (1 year) were selected for this study. The study included self administered questionnaire, which include the recurrence of

stone formation, family history, and water intake, over weight and obesity, dietary habits, lifestyle modifications association with other diseases (Hypertension, Diabetes and UTI).

RESULTS

The study was conducted among 666 kalladaippu patients. Out of them, 430 were males (64.56%) and 236 were females (35.44%). In our study the male female ratio was 1.82:1. Scales et. al observed a dramatic increase from 1997 to 2002 of the adjusted rate of discharges for stone disease in females in a representative sample of United States population with a change in the prevalence by gender of treated stone disease from a 1.7:1 to 1.3:1 male-to-female ratio. 384 patients (57.50%) were between the age of 21 and 40. Prevalent between age is showed in Fig.1.It has been found that renal calculi is more prevalent between the age of 20 and 40. In our study all the renal calculi patients were literate and majority of the patients (55.70%) were belonged to upper socioeconomic status as per the modified Kuppuswamy,B scale. The Sociodemographic parameters of the study patients are illustrated in Table.1. The number of patients visited for the treatment of kidney stone during each seasons were showed in Fig.2. 37.68% of patients visited in OPD for treatment during summer season (April to June). The annual maximum average temperature in Chennai, Tamilnadu, India is 33.1 c (91.6 degrees Fahrenheit).The highest temperature is often registered in May which is the hottest month in the state. The skilled occupation (39.03%) had the highest relationship with renal calculi. In recent years the epidemiology of urinary stone disease was still changing as social conditions gradually improved particularly in the urban areas of the more affluent developing countries.

Out of 666 patients, we found that 288 (43.24%) patients had already stones in their life time. 154 (23.12%) patients had family history of kidney stone. 480 (72.07%) patients did not drink required water (2-3 lit/day) daily.450 (67.56%) patients sweat a lot every day.165 (24.77%) patients were used NSAID frequently for pain. 365 (54.80%) patients were observed BMI between <25 and ≥39.99, of which 131 (35.89%) patients were observed as childhood obesity.

188 (28.22%) patients were observed problem in voiding. We found that 304 (45.64%) patients had stressful life. We observed that among 666 patients, 184 (27.62%) patients had the habit of late night eating. We observed that only 39 (5.85%) patients were pure vegetarians, 17 (2.55%) were non vegetarians and 610 (91.59%) patients were mixed diet. Out of 666 patients, we found that 383 (57.50%) patients consume coffee and tea more than 8 ounce a day and 118 (17.71%) patients consume soft drinks.428 (64.26%) patients taking higher sodium intake, among them 220 (51.40%) patients frequently consume processed foods.332 (49.84%) patients taking high sugar and only 2(0.3%) patients taking soya.

We also found that 240 (36.03%) patients have the habits of smoking and 277 (41.59%) patients have the habits of alcohol consumption. We observed that 285 (42.79%) patients were lacks of physical activity. 227 (34.08%) patients were associated with hypertension, 178 (26.72%) patients were associated with Diabetes and 106 (15.91%) patients were associated with UTI. Only one patient had the history of ovaries removed and 1 (0.15%) patient was associated IBD and 3 (0.45%) patients were rapid weight loss.

DISCUSSION

Stone formation in the urinary tract has been recognised for thousands of years, but during the last few decades the pattern and incidence of the disease have changed markedly. Urinary stone affect 10-12% of the population in industrialized countries. The average lifetime risk of stone formation has been reported in the range of 5-10%. Recurrent stone formation is a common part of the medical care of patients with all types of stone disease. The incidence of Urinary stones has been increasing recently. With a prevalence of >10% and an expected recurrence rate of nearly 50%, stone disease has an important effect on the health care system. Dr MG Rajamanickam, member of the Urological Society of India said that Kidney stone formation can happen to anyone and usually, 5-10% of our Indian population (over 50-100 million people) are affected by this condition (The Hindu August 30, 2012).

In our study the male female ratio was 1.82:1. Epidemiological studies

revealed that nephrolithiasis is more common in men (12%) than in women (6%) and is more prevalent between the ages of 20 to 40 in both sexes. Initial presentation predominates in the 3rd and 4th decades. Some of the studies reported that in developing countries the male-to-female ratio range from 1.15:1 in Iran and 1.6:1 in Thailand to 2.5:1 in Iraq and 5:1 in Saudi Arabia .

Kidney stones develop more frequently in individuals with a family history of kidney stones than in those without a family history. In our study the family history is significant association (p=0.009) between kidney stone. Studies had proved that a family history of stones has been reported in 16% to 37% of patients who have formed a kidney stone, compared with 4% to 22% in healthy control subjects. A family history of kidney stones substantially increases the risk of stone formation. The relative risk increased in patients with family history for calculus, with the tendency to eat protein-rich food and with overweight and body mass index (BMI)>32kg/m². A patient with stones is twice as likely as a stone-free cohort to have at least one first degree relative with renal stones (30%vs50%). Those with a family history of stones have an increased incidence of multiple and early recurrences.

Our study has significant association between recurrent stone formations. The recurrence of kidney stone will form within 5 to 7 years is approximately 50%. Low urine volume is the most common abnormality and the single most important factor to correct so as to avoid recurrences. Diets low in salt (<50mmol/day) and animal proteins (< 52gm/day) are helpful in decreasing the frequency of recurrent calcium oxalate stones.

Geographic factors contribute to the development of stones. Areas of high humidity and elevated temperatures appear to be contributing factors, and the incidence of symptomatic ureteral stones is greatest during hot summer months. Individuals living in hot climates are prone to dehydration, which results in an increased incidence of urinary stones, especially uric acid calculi. Although heat may cause a higher fluid intake, sweat loss results in lowered voided volumes.

In our study we found a significant relationship between dehydration and kidney stone. Robertson stated that the increased incidence of renal stone disease in the tropics where the risk of stone formation is compounded by low urine volume. As living standard increase, particularly in the urban areas of the more affluent developing countries, so the incidence of upper urinary tract stones is increasing being characterised by calcium oxalate stones often mixed with calcium phosphate and uric acid. Hot climates usually expose people to more ultraviolet light, increasing vitamin D3 production. Increased calcium and oxalate excretion has been correlated with increased exposure time to sunlight. Global warming may increase the incidence of urinary stone disease. High urinary calcium oxalate saturation occurs in men during summer season and in women during early winter.

Renal stones are more common in affluent, industrialized countries. Immigrants from less industrialized nations gradually increase their stone incidence and eventually match that of the indigenous population. Use of soft water does not decrease the incidence of urinary stones. Occupation can have an impact on the incidence of urinary stones. Physician and white collar workers have an increased incidence of stones compared with manual labourers. This finding may be related to differences in diet but also may be related to physical activity. Physical activity may agitate urine and dislodge crystal aggregates.

In this study we could establish a significant relationship between high intake of animal protein, sodium, sugar, coffee and tea. But we have not found a significant relationship between soft drinks and kidney stone. Diet plays an important role in the development of kidney stones, especially in patients who are predisposed to this condition. A diet high in sodium, fats, meat and sugar, low in fibre, vegetable protein and unrefined carbohydrates are increase the risk of kidney stones. Oxalate is found in green beans, tomatoes, nuts, chocolates and tea which increase the risk for kidney stones. Vegetarians have a decreased risk of developing stones. Studies have shown that even among meat eaters those who ate higher amounts of fresh fruits and vegetables had a lower incidence of stones. Studies have shown that even among meat eaters those who at higher amounts of fresh fruits and vegetables had a lower incidence of stones.

Changes in diet, life-style and obesity increase the incidence of nephrolithiasis. Nowfar et al. reported that a significant positive correlation exists between obesity and nephrolithiasis for both genders; however, obese females were more likely to develop stones than obese males. Patients with central adiposity or high waist-to-hip ratios appear to have the highest risk. Curhan et al. found that the prevalence and incidence of calcium oxalate stone disease was directly associated with body mass index (BMI). Without lifestyle changes and appropriate medical intervention stone rates can be as high as 50% within 5 years.

Regular moderate exercise reduces the risks associated with stones, such as hypertension and diabetes. Type 2 diabetes mellitus is characterized by insulin resistance, a metabolic derangement that may increase the risk of kidney stone formation. Eric N Taylor et.al, in their study reported that a history of diabetes mellitus was independently associated with a history of nephrolithiasis. People with Type 2 diabetes mellitus have highly acidic urine that can lead to kidney stones, particularly uric acid stones.

A high frequency of kidney stone formation among hypertensive patients has been reported, and among those with high body mass index as well. Hypertension is one of the major causes of development of renal failure. ESWL is associated with greater prevalence of hypertension. Cappuccio et.al reported that hypertensive men had a greater risk of developing kidney stones than normotensive ones.

Gout, a painful inflammatory arthritis induced by the deposition of monosodium urate monohydrate crystals in tissues has been linked with kidney stone disease in several studies. Yu and Gutman reported a 15% to 22% prevalence of kidney stone disease among individuals with gout, greater than the 12% lifetime risk reported in the general population. Holly J Kramer et.al in their study reported that there was no significant association between history of kidney stone disease and risk of incident gout in the multivariate-adjusted model (RR 0.72; 95% CI 0.32 to 1.60).

Walter D.C in his study reported that stressful lifestyles have been shown to increase lithogenic urinary constituents (calcium, oxalate and uric acid); with peak concentrations occurring within 24 hours period after an individual is subjected to stress [51]. Reza Najem G et.al stated that increased production of PTH under stressful events could cause an increase in serum calcium concentrations, which resulting hypercalciuria. One study reported that, major stressful life experience increased the risk of stone formation. This increased risk may be due to a hormone called vasopressin which is released in response to stress. Vasopressin also decreases the urine volume, which makes the chemicals in more concentrated and prone to form crystals and stones.

Holmgren K et.al in their study reported that there was a higher frequency of magnesium ammonium phosphate (MAP) calculi among patients with Proteus infection and more phosphate-containing stones (CaP + MAP) among Patients infected with E. coli. But there were no E. coli infections seen in male patients with CaP and MAP calculi.

Increased sodium intake will increase sodium and calcium excretion, increase monosodium urate saturation (that can act as a nidus for stone growth), increase the relative saturation of calcium phosphate, and decrease urinary citrate excretion. All of these factors encourage stone growth. According to the World Health Organization, **the daily consumption of salt should not exceed 5 grams or one teaspoon**. The average Indian salt consumption is 9 to 10 grams per day. This must be reduced in to <2300mg sodium/day. Reduction in dietary sodium helps to reduce recurrent calcium nephrolithiasis.

Fluids intake and urinary output may have an effect of urinary stone disease. The average daily urinary output in stone formers is 1.6 L/d. A low fluid intake, with a subsequent low volume of urine production, produces high concentrations of stone forming solutes in the urine. High fluid intake may be beneficial not only to prevent CaOx overgrowth, but also to reduce plaque formation itself. One of the goals of kidney stone treatment is to keep your urine as dilute as possible. This helps to keep the substances that could potentially form a kidney stone, such as calcium and oxalate moving quickly through the

urinary tract. Caffeine contains beverages like coffee, tea and cola to one or two cups a day, science caffeine acts as a diuretic, causing your body to lose fluids too quickly and the urine to become too concentrated. Furthermore, both coffee and tea contain high levels of oxalate, a common component of kidney stones.

A diet high in animal protein—from meat, chicken and fish may cause the body to release too much calcium, uric acid and citrate in the urine. Red meat, tinned fish, meat extracts and muscles are rich in purine, which in turn increases the uric acid concentration. Protein intake should be limited to 1gm/kg/day. Recurrent kidney stones may form in patients who are sensitive to the chemical by products of animal protein and who consume large amount of meat. An increased protein load can also increase calcium, oxalate, and uric acid excretion and decrease urinary citrate excretion.

The ingestion of sucrose and other simple sugars causes an exaggerated increase in the urinary calcium oxalate content in approximately 70% of recurrent kidney stone formers. Much of the sugars consumed today are “hidden” in processed foods that are not usually seen as sweets. Adults who consume less sugar have lower body weight and, second, that increasing the amount of sugars in the diet is associated with a weight increase. In addition, research shows that children with the highest intakes of sugar-sweetened drinks are more likely to be overweight or obese than children with a low intake of sugar-sweetened drinks. Sugar stimulates the pancreas to release insulin, which in turn causes extra calcium to be excreted in the urine. Excess weight and insulin insensitivity lead to hyper calciuria and are high-risk factors for stone formation. Urinary pH falls with increasing body weight, probably because of insulin resistance causes uric acid stones. Patients with rapid weight loss have an increased incidence of uric acid lithiasis.

Mohammad Reza Tamadon et.al, in their study the proportion of smokers among patients with nephrolithiasis was significantly higher than in the control subjects. Cigarette smoking was 2.06 times more common in stone formers than in the control group. Hence, smoking may be an independent risk factor for nephrolithiasis. One of the possible factors which may explain the effect of smoking on stone formation is a high body cadmium and lead level in smokers. Cigarette smoking may induce urolithiasis by decreasing urinary flow and increasing serum cadmium in healthy subjects. Also, Scott et al in their study proposed that increased serum cadmium levels associated with cigarette smoking may be a risk factor for urinary tract stone formation.

Hyperoxaluria may develop in patients with bowel disorders, particularly inflammatory bowel disease, small-bowel resection, and bowel bypass. Renal calculi develop in 5-10% of patients with these conditions. Estrogen actually lowers the risk of hyperoxaluria. Estrogen increases citrate excretion and may be a factor that decreases the incidence of stone formation in women, especially during pregnancy. **Postmenopausal** women with low **estrogen** levels have an increased risk for kidney stones. Women who have had their ovaries removed are also at increased risk.

CONCLUSION

In this study, we could establish a significant relationship between family history, diet and life style modifications, low fluid intake, obesity are the major factors play a role in development of renal calculi. We also found a significant relationship between patients associated with diabetes mellitus, hypertension and renal calculi. Life style changes helps to reduce recurrent stone disease. Renal calculi can be prevented by the most important thing is to drink plenty of water daily the goal should be to urinate from two to four litters per day make sure you avoided getting dehydrated, there are no specific dietary recommendation until a stone from your system has been analysed. After analysis diet can be evaluated and changes recommended.

LIST OF ABBREVIATIONS

AUA =American Urological Association

BMI=Body mass index

CaOx = Calcium oxalate

CKD= Chronic kidney disease

ESRD =end-stage renal disease

ESWL = Extracorporeal shock wave lithotripsy

IBD=Irritable bowel disease

MAP =Magnesium ammonium phosphate

NIS = National Institute of Siddha

NSAID=Non steroidal anti inflammatory drugs

OPD = Out Patient Department

PTH=Parathyroid hormone

UTI=Urinary tract infection

WHO = World Health Organization

ACKNOWLEDGEMENTS: The authors are grateful to the assistance of Dr. H. Anitha virgin kumari, Asst. Professor, Department of Obstetrics & Gynaecology, Stanley Medical College, Chennai who helped us to create this manuscript with her honest cooperation.

CONFLICT OF INTEREST

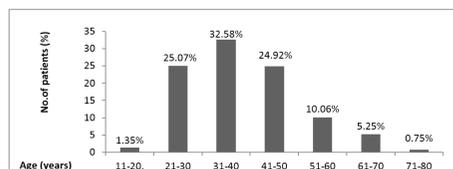


Figure 1. Prevalent between the ages

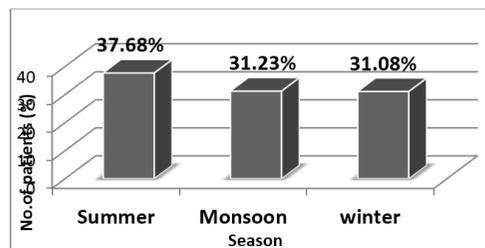


Figure 2. Relationship towards Season

Table 1: Sociodemographic parameters of the study patients

Sociodemographic determinants	Number (n=666)	Percentage (%)
Age (in years)		
11-20	9	1.35
21 -30	167	25.07
31 - 40	217	32.58
41 -50	166	24.92
51 - 60	67	10.06
61-70	35	5.25
71 - 80	5	0.75
Gender		
Male	430	64.56
Female	236	35.44
Socioeconomic data		
Upper	371	55.70
Upper middle	83	12.46
Lower middle	122	18.31
Upper lower	90	13.51
Lower	0	0

Religion		
Hindu	589	88.43
Muslim	36	5.40
Christian	41	6.15
Education		
Illiterate	0	0
Literate	666	100
Occupation		
Profession	106	15.91
Semi-profession	83	12.46
Clerk, shop owner, farmer	58	8.70
Skilled work	260	39.03
Semi-skilled work	53	7.95
Unskilled work	95	14.26
Unemployed	11	1.65
Marital status		
Married	496	74.47
Un married	170	25.53

Table-2: Association of Risk factors with Renal calculi patients

Sl.no	Risk factors	Number (n=666)	Percentage (%)
1.	Already stones in their life time	288	43.24
2.	Family history of kidney stone	154	23.12
3.	Did not drink required water (2-3 lit/day) daily	480	72.07
4.	Sweat a lot every day	450	67.56
5.	Used NSAID frequently	165	24.77
6.	BMI between <25 and ≥39.99	365	54.80
7.	Childhood obesity	131	35.89
8.	Problem in voiding	188	28.22
9.	Stressful life	304	45.64
10.	Habit of late night eating	184	27.62
11.	Pure vegetarians	39	5.85
12.	Non vegetarians	17	2.55
13.	Mixed diet	610	91.59
14.	Consume coffee and tea more than 8 ounce a day	383	57.50
15.	Consume soft drinks	118	17.71
16.	Higher sodium intake	428	64.26
17.	Frequently consume processed foods	220	33.18
18.	Taking high sugar	332	49.84
19.	Soya	2	0.3
20.	Habits of smoking	240	36.03
21.	Alcohol consumption	277	41.59
22.	Lacks of physical activity	285	42.79
23.	Associated with hypertension	227	34.08
24.	Associated with Diabetes	178	26.72
25.	Associated with UTI	106	15.91
26.	History of ovaries removed	1	0.15
27.	Rapid weight loss	3	0.45

REFERENCES

- Global Warming May Lead To Increase In Kidney Stones Disease *Science Daily* (May 15, 2008)
- People Who Develop Kidney Stones Are At Increased Risk For Chronic Kidney Disease. *Science Daily* (Nov. 17, 2008)
- Guidelines on Urolithiasis (*Text update April 2010*) Ch. Türk (chairman), T. Knoll (vice-chairman), A. Petrik, K. Sarica, C. Seitz, M. Straub, O. Traxer
- Amato M, Lusini ML, Nelli F. Epidemiology of Nephrolithiasis today. *Urol-Int* 2004;72,suppl 1:1-5
- Resnick M, Pridgen DB, Goodman HO. Genetic predisposition to formation of calcium oxalate renal calculi. *N.Eng.J. Med* 278:1313-1318;1968
- Alberto Trinchieri, Epidemiology of urolithiasis: an update. *Clin Cases Miner Bone Metab.* 2008 May-Aug; 5(2): 101-106.
- Khan AS, Rai ME, Gandapur Gandapur, Pervaiz A, Shah AH, Hussain AA, Siddiq M. Epidemiological risk factors and composition of urinary stones in Riyadh Saudi Arabia. *J Ayub Med Coll Abbottabad.*2004;16:56-8. [PubMed]
- Safarinejad MR. Adult urolithiasis in a population-based study in Iran: prevalence, incidence, and associated risk factors. *Urol Res.* 2007; 35:73-82. [PubMed]
- Tanthanuch M, Apiwatgaroon A, Pripatnanont C. Urinary tract calculi in southern Thailand. *J Med Assoc Thai.* 2005;88:80-5. [PubMed]
- Qaader DS, Yousef SY, Mahdi LK. Prevalence and etiology of urinary stones in hospitalized patients in Baghdad. *East Mediterr Health J.* 2006; 12:853-61. [PubMed]
- Trinchieri A, Mandrassi A, Luongo P, Coppi F, Pisani E. Familial aggregation of renal calcium stone disease. *J. Urol* 139:478-481; 1988.
- Ljunghalls, Hedstrand .H: Epidemiology of renal stones in a middle-aged male population. *Acta Med Scand* 197:439-445; 1975.
- Gary C.curhan, Walter C.willet, Eric B.Rimm and Meir J.stampfer. Family history and risk of kidney stones. *Jasn.asnjournals.org.*
- KupPuswamy.B. Manual of socioeconomic status (urban), Manasayan, Delhi, 1981.
- Malvinder S.parmar, Kidney stones, *BMJ* 2004 June 12,328(7453):1420-1424.

16. Ross WR, McGill JB. Epidemiology of obesity and chronic kidney disease. *Adv Chronic Kidney Dis*.2006; 13:325–35. [[PubMed](#)]
17. Sakhaee K, Harvey JA, Padalino PK,Whitson P, Park CY. The potential role of salt abuse on the risk for kidney stone formation. *The Journal of Urology* 1993;150 (2pt1)310-312.
18. WHO calls on countries to reduce sugars intake among adults and children, Press release 4 MARCH 2015 | GENEVA
19. Ramello A, Vitale C, Marangella M, Epidemiology of Nephrolithiasis. *J.Nephrol*.2000 Nov-Dec; 13, suppl 3; 345-350.
20. Scales CD Jr, Curtis LH, Norris RD, Springhart WP, Sur RL, Schulman KA, Preminger GM. Changing gender prevalence of stone disease. *J Urol*. 2007; 177:979–82. [[PubMed](#)]
21. Asplin JR, Favus MJ, Coe FL; Nephrolithiasis.In: Brenner BM ed. Brenner and Rector's the kidney. 5th edition. Philadelphia: Saunders 1996:1893-935.
22. Robertson WG. Renal stones in the tropics. *Semin Nephrol*. 2003; 23:77–87. [[PubMed](#)]
23. [Malvinder S Parmar](#), Kidney stones. *BMJ* 2004; 1420-1424
24. Curhan GC,Willett WC, Speizer FE, Stampfer MJ.Body size and risk of kidney stone. *J.Am Soc Nephrol* 1998;9:1645-52([PubMed](#))
25. Nowfar S, Palazzi-churask, Chang DC, Sur RL. The relationship of obesity and gender prevalence changes in United States inpatients nephrolithiasis. *Urology* 2011; 78:1029-33([PubMed](#)).
26. Smith and Tanagho's General Urology. 18th Edition, Mc Graw Hill, Lange.
27. Text book of Natural Medicine 2nd edition.Vol.2. Joseph E. Pizzorno jr. Michael T. Murray.1999. Churchill Livingstone, Edinburgh.
28. Massey LK. Dietary salt, urinary calcium and kidney stone risk. *Nutr Rev* 1995; 53:131-139.
29. Blacklock NJ. Sucrose and idiopathic renal stone. *Nutr. Health* 1987;5:9-17
30. Coe F, Moran E, Kavalich A. The contribution of dietary purine over-consumption to hyperuricosuria in calcium oxalate stone formers. *J Chron Dis* 1976;29:793-800
31. Arunava Choudhury, Text book of Urology. New Central Book Agency (p) Ltd. Kolkata.1st edition 2012.
32. Text book of Biochemistry with clinical correlations. Thomas M. Devlin.7th edition 2011, John wiley & Sons, Inc. United States of America.
33. Fredric L. Coe, Andrew Evan and Elaine Worcester Kidney stone disease. *J Clin Invest*. 2005;115(10):2598–2608
34. Durak I, Sahin A, Perk H. Smoking, hair cadmium and urinary tract stones. *Eur Urol*. 1990;17(3):267–8. [[PubMed](#)]
35. 18. Mortada WI, Sobh MA, El-Defrawy MM. The exposure to cadmium, lead and mercury from smoking and its impact on renal integrity. *Med Sci Monit*. 2004;10(3):CR112–6. [[PubMed](#)]
36. 19. Scott R, Cunningham C, McLelland A, Fell GS, Fitzgerald-Finch OP, McKellar N. The importance of cadmium as a factor in calcified upper urinary tract stone disease--a prospective 7-year study. *Br J Urol*.1982;54(6):584–9. doi: 10.1111/j.1464-410X.1982.tb13601.x. [[PubMed](#)]
37. Mohammad Reza Tamadon, Mohammad Nassaji, and Raheb Ghorbani Cigarette Smoking and Nephrolithiasis in Adult Individuals. *Nephrourol Mon*.2013 winter; 5(1): 702–705.
38. Maalouf, NM, et al. Association of urinary pH with body weight in nephrolithiasis. *Kidney Int*. 2004. **65**:1422-1425. [[Pub Med](#)]
39. Taylor EN, Stampfer MJ, Curhan GC: Obesity, weight gain, and the risk of kidney stones. *JAMA* 293:455-462, 2005.
40. H. Nalini Sofia, K. Manickavasakam, A Pilot Study Evaluating Therapeutic Efficacy of Siddha Formulation 'Nandukkal Parpam' in the Management of Renal Calculi. *Current Traditional Medicine*, **1**(2): 98-102, 2015.
41. Curhan GC, Willett WC, Rimm EB, Stampfer MJ; A prospective study of dietary calcium and othe nutrients and the risk of symptomatic kidney stones. *N Engl J Med* 328:833-838, 1993.
42. Taylor EN, Curhan GC: Fructose consumption and the risk of kidney stones. *Kidney Int* 73: 207-212, 2008.
43. John C. Lieske: New insights regarding the interrelationship of obesity, diet, physical activity, and kidney stones. *Journal of the American society of nephrology*, vol 25, no.2, 211-212, 2014.
44. Eric N Taylor, Meir J Stampfer , Gary C Curhan: Diabetes mellitus and the risk of kidney stones. *Kidney Int* 68: 1230-1235, 2005.
45. Beck-Nielsen.H, Groop.LC, Metabolic and genetic charectarization of prediabetic states. Sequence of events leading to non-insulin-dependent diabetes mellitus. *J Clin Invest* 94: 1714-1721, 1994.
46. Holly J Kramer, Hyon K Choi, Karen Atkinson, Meir Stampfer and Gary C Curhan The association between gout and nephrolithiasis in men: The Health Professionals' Follow-Up Study, *Kidney International* (2003) **64**, 1022–1026.
47. [Holmgren K](#), [Danielson BG](#), [Fellström B](#), [Ljunghall S](#), [Niklasson F](#), [Wikström B](#). The relation between urinary tract infections and stone composition in renal stone formers. *Scand J Urol Nephrol*. 1989; 23(2):131-6.
48. Emin Ozbek: Induction of Oxidative Stress in Kidney, *International Journal of Nephrology* Volume 2012, Article ID 465897, 9 pages.
49. Cappuccio, Francesco P; Siani, Alfonso; Barba, Gianvincenzo; Mellone, Maria Cristina; Russo, Luigina; Farinaro, Eduardo; Trevisan, Maurizio; Mancini, Mario; Strazzullo, Pasquale A prospective study of hypertension and the incidence of kidney stones in men *Journal of Hypertension: July 1999 - Volume 17 - Issue 7 - p 1017-1022*.
50. G.Reza Najem, Joseph J Seebode, Ahmed J.Samady,Martin Feuerman and Lawrence Friedman. Stressful life events and risk of symptomatic kidney stones.*International journal of Epidemiology*, volume 26, no.5, 1997.
51. Walters DC. Stress as a principal cause of calcium oxalate urolithiasis. *Int. Urol. Nephrol* 1986;18,271-75.