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# Epidemiology of Urinary Stones

**G Madhurambal[a], N Prabha[b] and S Ponsadi Lakshmi[b]**

[a]Associate Professor of Chemistry, ADM College for women, Nagapattinam.
[b]Assistant Professor in Chemistry, ADM College for Women, Nagapattinam.

## ABSTRACT

Stones are more common in men than in women. Stone formation in renal systems in one of the oldest and the most common form of crystal deposition. Populations that consume diets rich in animal protein have a higher risk of stones than those with a more vegetarian diet. The risk of forming a stone is increased further by a high intake of refined sugar, salt and oxalate-rich foods. Living and working in a hot environment or engaging in regular vigorous exercise can increase the risk of forming stones by decreasing urine volume as a result of dehydration from sweating. Obesity results in increased urinary excretion of stone formation. Forty six samples are collected from various Hospitals with survey of various factors in the form of questionnaire from the patients. From the questionnaire, a detailed statistical study on the Epidemiology of the kidney stones. The study is based on the on the basis of Age, Symptoms, Food habits, Occupation, Obesity, Sexual correlation and Recurrence is discussed with in the study. Stones are removed surgically, ureterscopy and 'crushing and evacuation' method . Though a large number of crystals are collected, only ten samples are measurable in size due to surgical operation and the rest of them are removal by laparoscopy. The seasonal variation plays an important role in the formation of kidney stones.

**Key words :** Urinary Stone; Epidemiology; Age; Sex; Symptoms; Food habits; Occuption; Obesity.

***Corresponding author***

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## INTRODUCTION

Disease of renal calculi is known to be one of the oldest, diseases leading to hospitalization and surgery. In India it affects nearly 2 million people every year and the life time risk is about 20% in those having this disorder. Northern part of India is defined as the stone forming belt and the incidence is low in Southern part. In 1980, the percentage of population, which had the incidence of stones in USA, Sweden, Germany, Italy and UK was found to be 12.0, 9.5,6.8, 3.1 and 1.5 respectively. In the United States the probability of formation of the renal calculi in the adult population is 2%. The pediatric problem of bladder stone was found to be a continuous problem in Southeast Asia. Urolithiasis is found to be a multifactorial disorder, among the fluid intake, geographical location, climate etc., In many countries, the geographical distribution of renal calculi is uneven. So a precise knowledge of the epidemiological factors and composition of the urinary stones with respect to the geographical location is essential for suggesting a better method of treatment and also to avoid the factors which could influence their recurrence.

Regarding costs, urinary stone disease is increasingly treated on an outpatient basis, the number of inpatient discharges for a diagnosis of urolithiasis has been declining gradually. Nevertheless, in 2007, the Nationwide inpatient sample recorded 155,860 urinary stone inpatient discharges. The actual cost for treatment of urinarystone disease would probably be several orders of magnitude greater if outpatient procedures were included. Proper acute and long-term management of such patients is therefore essential.

There is no recent epidemiological study from Chennai city and old Thanjavur district area. In order to have an idea of the prevalence of the stone disease in Chennai and Thanjavur district an investigation was made on the patients who were admitted for the treatment of urinary calculus disease in Stanley Medical College Chennai and SP Hospital Thanjavur with survey of various factors in the form of questionnaire. The work presented here is a consolidated report of the data collected during March 2010 to January 2011.

## DATA COLLECTION

There are no population based data on the incidence or prevalence of kidney stones in Tamil nadu. Estimates of the incidence of first kidney stones between the ages of 30 and 70 years vary between approximately 100-300/100000/year in men and 50-100/100000/year in women [1-4]. Overall, the prevalence of kidney stones is approximately 6-9% in men and 3-4% in women and this appears to be increasing [2-7].

In the study, a series of 46 cases of urinary stone disease was documented. By analyzing the case histories, the distribution of stone incidence in different sex, age and occupation was studied. The symptoms, food habits, heredity and recurrence of the disease in each patient were noted. The details of the stones such as location of the stones, mode of stone removal, and number of stones, size and weight of the stones, colour and appearance of surface of the

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stones were observed. The composition of the stones was determined by different analyses. These are tabulated in Table.1

**TABLE.1**

| CASE | SEX | AGE | OCCUPTION | SYMPTOMS | DURATION OF SYMPTOMES | RECURRANCE |
|---|---|---|---|---|---|---|
| 1 | M | 36 | Coolie | loin Pian | 6 Months | - |
| 2 | M | 42 | Coolie | Irritation | 2 Months | - |
| 3 | M | 39 | Coolie | loin Pian | 4 Months | - |
| 4 | M | 65 | Coolie | Irritation | 8 Months | - |
| 5 | M | 45 | Coolie | Irritation | 1 Year | - |
| 6 | M | 50 | Coolie | loin Pian | 8 Months | 1 |
| 7 | M | 36 | Coolie | Irritation | 6 Months | - |
| 8 | M | 39 | Coolie | Irritation | 4 Months | - |
| 9 | M | 48 | Coolie | Irritation | 5 Months | - |
| 10 | M | 42 | Coolie | loin Pian | 3 Months | - |
| 11 | M | 38 | Coolie | Irritation | 6 Months | - |
| 12 | M | 40 | Coolie | Irritation | 2 Months | - |
| 13 | M | 38 | Coolie | Irritation | 4 Months | - |
| 14 | M | 39 | Coolie | Irritation | 6 Months | - |
| 15 | M | 41 | Coolie | Irritation | 4 Months | - |
| 16 | M | 36 | Coolie | Irritation | 8 Months | - |
| 17 | M | 45 | Coolie | loin Pian | 8 Months | - |
| 18 | M | 36 | Coolie | loin Pian | 1 Year | - |
| 19 | F | 42 | Coolie | Irritation | 1 and half Years | - |
| 20 | F | 65 | Coolie | loin Pian | 9 Months | - |
| 21 | M | 38 | Farmer | Irritation | 1 Year | - |
| 22 | M | 46 | Farmer | Irritation | 8 Months | - |
| 23 | M | 56 | Farmer | loin Pian | 6 Months | - |
| 24 | M | 48 | Farmer | Irritation | 1 Year | - |
| 25 | M | 52 | Farmer | loin Pian | 7 Months | - |
| 26 | M | 37 | Clerk | Irritation | 1 Year | - |
| 27 | M | 56 | Typist | loin Pian | 1 Year | - |
| 28 | F | 39 | Junior Assistant | loin Pian | 8 Months | - |
| 29 | M | 42 | Driver | Irritation | 8 Months | - |
| 30 | F | 40 | Business | loin Pian | 9 Months | - |
| 31 | M | 36 | Business | Irritation | 1 Year | - |
| 32 | M | 43 | Business | Irritation | 8 Months | - |
| 33 | M | 52 | Business | Irritation | 4 Months | - |
| 34 | M | 46 | Business | Irritation | 6 Months | - |
| 35 | F | 35 | House Wife | loin Pian | 4 Months | - |
| 36 | F | 36 | House Wife | Irritation | 6 Months | - |
| 37 | F | 52 | House Wife | Irritation | 8 Months | 1 |
| 38 | F | 47 | House Wife | loin Pian | 2 Months | - |
| 39 | F | 50 | House Wife | loin Pian | 9 Months | - |
| 40 | F | 49 | House Wife | Irritation | 7 Months | - |
| 41 | F | 37 | House Wife | Irritation | 8 Months | - |
| 42 | F | 49 | House Wife | loin Pian | 9 Months | - |

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| | | | | | | |
|---|---|---|---|---|---|---|
| 43 | F | 47 | House Wife | loin Pian | 1 Year | - |
| 44 | F | 10 | Student | Irritation | 6 Months | - |
| 45 | M | 14 | Student | Irritation | 4 Months | - |
| 46 | M | 58 | Coolie | Irritation | 1 Year | - |

**SEX**

Men are at greatest risk of developing kidney stones with incidence and prevalence rates between two and four times that of women [2, 3]. The ratio has decreased from 3:1 male to female predominance to less than 1.3:1 and this is due in part to lower testosterone levels providing protection for women and children against developing oxalate stones, as testosterone may increase hepatic oxalate production.

A 15 year retrospective study by Baker et al. [8] found that the peak age for the development of calcium oxalate stones was between 50 and 60 years. Men were at greater risk of producing Calcium oxalate stones and uric acid stones. Women were at greater risk of infection stones. In a separate study by Gault and Chafe in Canada, women were also found to be more likely to produce calcium phosphate stones than men [9].

Our analysis of the distribution of the disease in different sex has shown that, out of the 46 cases, 70% were males and 30% were females. The diagram is shown in Figure.1

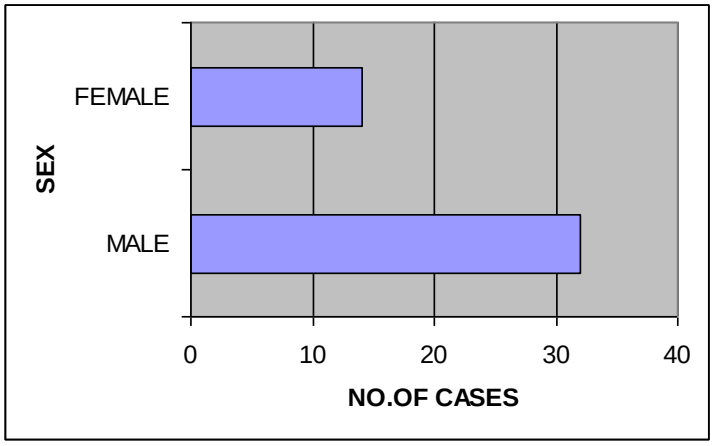


**FIGURE.1**

**AGE**

The histogram shows the distribution of the disease in different age groups are shown in figure.2. The incidence of urinary calculus was high between 41-50 age group. Next to this, the incidence was found to be high in the age group 31-40 and 51-60. The incidence was lowest among children (below 10 years) and was less in elders (above 60 years). The eldest in the series was one male and one female patient of age 65 years and the youngest was a girl of 10 years. Sex distribution in different age groups is shown in the histogram from figure from which

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it is clear that the incidence of stone disease is high in both sex between the age group of 41-50.

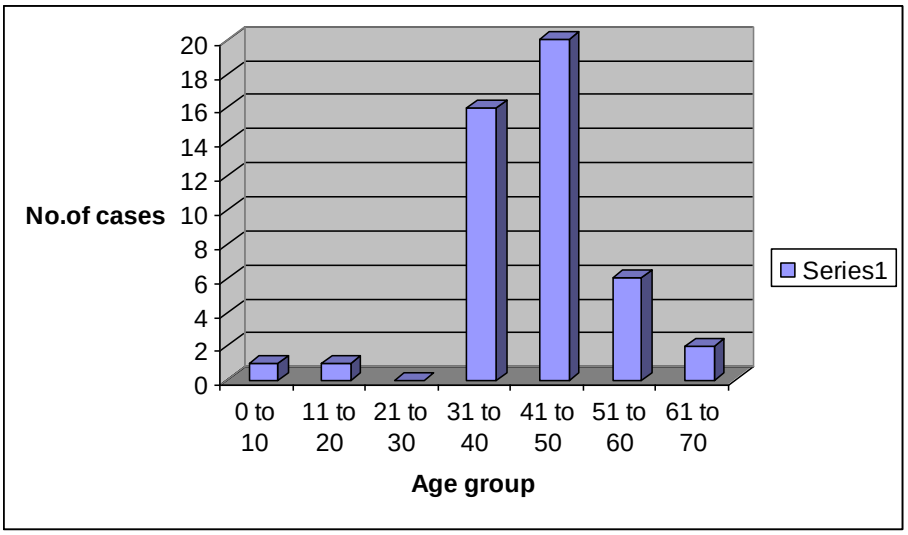


**FIGURE.2**

Our study in Tamil Nadu population is based on cohort study. An underlying contributing factor was found in 70% of men presenting with their kidney stone (inflammatory bowel disease 30%, hyperthyroidism 20%, hyperparathyroidism 2%, urinary tract infection 10% and prolonged immobilization 8%). In a study of women, 30% had a potentially contributing medical condition including urinary tract infection at the time of stone formation or stone due to urinary infection (20%), hyperthyroidism (7%), inflammatory bowel disease (2%) and hyperparathyroidism (1%).

**OCCUPATION**

Sedentary occuptions, including professional and managerial groups, are associated with a higher incidence of urinary calculi than manual jobs. Stress is also associated with stone disease.

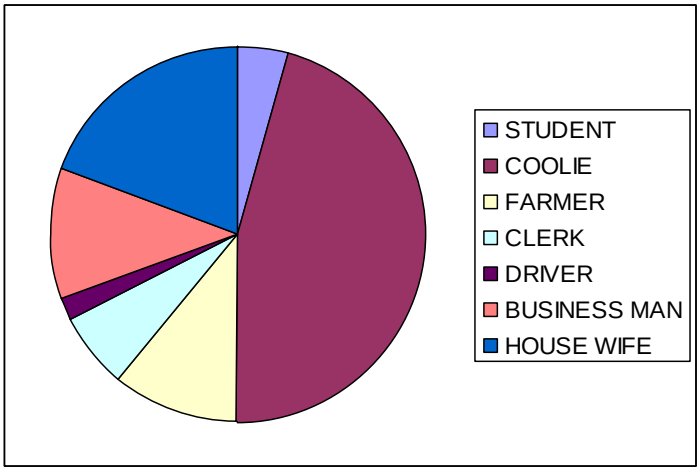


**FIGURE.3**

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Occupation is categorized into active (coolie, farmer, driver, businessman, housewife and Student) and sedentary are tabulated in Table.2. The present study shows that all the patients are physically active, shown in figure.3.

**TABLE.2**

| Occupation | Coolie | Farmer | Officer | Driver | Business | House wife | Student |
|---|---|---|---|---|---|---|---|
| No. of cases | 21 | 5 | 3 | 1 | 5 | 9 | 2 |

## SYMPTOMS AND DURATION OF THE SYMPTOMS

In our study 63 % of the patients had the symptom of loin pain. Many patients had irritation, difficulty and pain while passing urine are shown in figure.4. Some had the problem of vomiting, fever, suffocation and hematuria. The average time of onset of the symptom to the time of treatment varied from within a day to last twenty years.

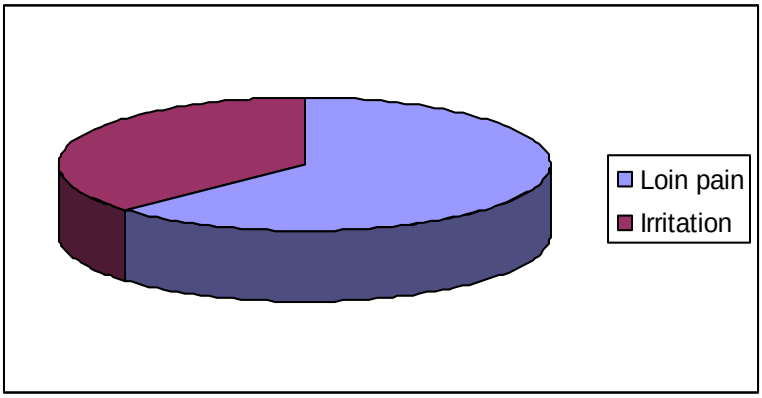


**FIGURE.4**

## REMOVAL AND OBSERVATION OF THE STONES

Stones were collected from twenty cases 46% of the patient's stones in kidney, 32% in ureter and the remaining had bladder stone. One uretric stone was passed spontaneously and another uretric stone was removed by laparoscopy. In 36 cases with bladder stones, 'crushing and evacuation' method was adopted for the stone removal. The remaining ten stones were removed 'surgically'. 80% of the patient's single stone 19% had multi stones. One male patient of 28 years had stone (with sizes varying from .4x1x1 $cm^3$ to pinhead), who had his previous stones a two years back and was removed laparoscopy.

Most of the kidney stones with greater size than 1x1x1 $cm^3$ of kidney stones weight of the stones varied from 100 mg. to 150g. A 46 years old female patient had a biggest stone of size 6.5x4x5.5 $cm^3$ and weight 120g. It was a bladder stone of struvite composition

Calcium oxalate monohydrate stones were black or dark brown in colour. On the other hand, calcium dehydrates stones were light brown in colour. Calcium oxalate monohydrate

kidney stones of different sizes. All the three calculi showed different external morphologies viz., the nodular surface morphology, the smooth surfaced stag horn morphology and irregular surface morphology. The cross section of a calcium oxalate monohydrate stone with radial stariation. It also shows the concentric laminations of different colours from centre to the periphery with a central nucleus. Two calcium oxalate dehydrate stone with rough surface.

Mixed composition of calcium oxalate and calcium phosphate stone with a smooth surface. Majority of the mixed (calcium oxalate and calcium phosphate) An exception of this kidney stones with highly polished surface and with some projections over the surface the cross section of two calcium oxalate and calcium phosphate mixed stones showed very different patterns one with a layered appearance with an inner linear cavity and another with an irregular pattern with a central nucleus.

A prospective study of 45 289 men in the United Stated failed to find an increased incidence of kidney stones over a 6 year period in the hotter south-eastern states; however, the prevalence of stones at baseline was higher in these states. This indicates that there was a modest increase in the risk of kidney stones in the hotter regions. Other studies performed in the United States and Isreal have indicated that the incidence of stone disease increases both in the hotter areas of the country and during the hottest months of the year.

**Metabolic abnormalities**

People who form kidney stones often have metabolic or other abnormalities detectable on urinary testing. The common abnormalities include low urinary volume, hypercalcuria (25-40%), hyperoxaluric (10-50%), hyperuricosuria (8-30%) and hyperoxaluria(5-30%) [10-14]. There is, however, significant overlap with healthy controls who also often have biochemical 'abnormalities', albeit less frequently [11, 14].

**OTHER ASSOCIATIONS AND RISK FACTORS**

**DIET**

The association between diet and kidney stones has long been suspected. Populations that consume diets rich in animal protein (meat, fish and poultry) have a higher risk of stones than those with a more vegetarian diet. The risk of forming a stone is increased further by a high intake of refined sugar, salt and Animal protein foods. Sucrose increases the urinary calcium and oxalate concentrations. Lack of dietary fibre is also thought to contribute stone formation, because fibre traps and decreases the rate and extent of absorption of sucrose and animal protein. Animal protein increases urinary calcium, oxalate and uric acid along with causing a more acidic urine, contributes to calcium oxalate over-saturation and precipitation. Prospective studies show that high dietary calcium intake reduces the risk of kidney stones, possibly by reducing gut absorption of oxalate [1, 15, 16]. Calcium supplements, however, might be associated with an increased risk of stone disease in older women although this has not been found in younger women [1, 17].

High fluid intake is associated with a lower risk of developing kidney stones in men and women [18, 19]. Certain beverages also appear to provide additional protection with coffee, tea, beer and wine consumption associated with reduced risk of kidney stones while grapefruit juice consumption was associated with an increased risk [18-20]. High quantity of water intake leads to urinary dilution of the constituents that may precipitate, as well as reducing the average time of residence of free crystal particles in urine. A high dietary intake of fruit and vegetables, a low fat dairy products, whole grains and contains only small amount of meat, sweats and sugar-containing beverages has also been associated with a lower risk of stone [21] and has other health advantages [36].

**OBESITY AND HYPERTENSION**

The relative risk of developing kidney stones was greater for obesity women than it was for men. Obesity results in increased urinary excretion of uric acid, sodium, phosphate and ammonium and decreased urinary pH all of which are associated with stone crystal formation. Insulin resistance has also recently been reported to be associated with low urinary ammonium and pH and increased risk of uric acid nephrolithiasis [22-24].

A modest association has been reported between hypertension and nephrolithiasis in both sexes [5, 25-27]. In prospective studies, people with a history of nephrolithiasis are more likely to develop hypertension [5, 26] and those with hypertension are more likely to develop kidney stones, especially when they are overweight [28, 29].

**MEDICATIONS**

Indinavir, a protease inhibitor used in the treatment of HIV-1 infection, can cause kidney stones composed mainly of the drug itself [30]. Other medications associated with stones include allopurinol, triamterene and trisilicate (silica stones) [31].

Vitamin C is metabolized to oxalate and has been shown in a small metabolic study to increase the urinary excretion of oxalate [32]. No association between vitamin C intake and the incidence of kidney stones has been demonstrated in women [33]. However, in an observational study, high vitamin C intake (>1000 mg/day) has been shown to be associated with an increased risk of stones in men, when compared with an intake of 90mg/day [21].

**STONE RECURRENCE**

Two cases were treated for the stone among these cases one case had passed a stone five months before and one had removal of the stone two years back.

**OTHER FACTORS**

Other factors reported to be associated with an increased risk of developing kidney stones include the absence of intestinal oxalate degrading bacteria [34, 35].

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## SUMMARY OF THE EVIDENCE

Although data on kidney stone disease in Tamil Nadu are limited, the available studies that the epidemiology is similar to foreign countries. Of particular interest in Chennai and Thanjavur district are the Stone disease is a common significant disorder and it is important to understand the risk factors and causes to be able to manage patients effectively likelihood that climate and racial background play a role in the risk of kidney stone disease and the identification of subgroups with in the community. Preventing recurrence, after stone clearance has been achieved, is a key part of managing stone disease.

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