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Research Article

# ASSESSMENT OF FLUID INTAKE IN UROLITHIASIS PATIENTS ATTENDING UROLOGY CLINIC AT A TERTIARY CARE CENTERIN NORTH KARNATAKA

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## ABSTRACT

Urolithiasis is a highly prevalent disease all over the world. The prevalence of kidney stone disease in India is around 12%. Fluid intake is one of the important modifiable risk factors in kidney stone disease which can be considered for preventive measures. Nevertheless, various kinds of fluids cannot have the same effect on stone formation. North Karnataka region is more prone to stone formation due to a lack of fluid intake in several parts. We aim to assess the intake of various fluids and beverages along with water in urolithiasis patients attending the urology clinic at the tertiary care centre. A total of 240 kidney stone patients attending a urology clinic at a tertiary care centre were enrolled for the study between the period of 2020 to 2021. Structured and validated questionnaires comprising detailed information about brief medical history, lifestyle habits and fluid intake habits were provided to the subjects. Kidney stones were collected from all 240 patients to analyse the chemical composition and spectral studies. Out of 240 patients, 152 were male patients and 88 were females. The overall male-to-female ratio was 1.72: 1. The mean Body Mass Index (BMI) of all the patients was 25.83. The highest numbers of cases (43.3%) were seen in the age group above 50. Around 65.8% of cases used to consume less than an adequate amount of water. In stone analysis, 58.3% were calcium oxalates and 16.6% were uric acid stones which was the second-highest among cases. Fluids like milk, tea, and fruit juices are shown to reduce the risk of stone formation to some extent whereas less water intake was a major risk factor. Alcohol and aerated beverages are still having controversial results in stone formation. So, more studies have to be conducted in different geographic regions which may help to prevent the reoccurrence and may reduce the burden of urolithiasis.

**Keywords:** Urolithiasis, Kidney stone, Fluid, North Karnataka, Beverages.

## 1. INTRODUCTION

Urinary stone formation or urolithiasis is an accumulation of a hard mass of crystals as a result of the supersaturation of urine with various salts and minerals [1]. According to the literature, the burden of urinary stones is increasing in recent decades comprising of its prevalence around 1.7% to 8.8% worldwide [2]. In India, around 12% of the total population is suffering from urolithiasis among which 50% may end up in damage of renal function if it's not treated or left undiagnosed [3]. Advancement in medical research has led to various treatment measures for urolithiasis, still, preventive measures have to be focused on to reduce the morbidity and cost burden on the patients with urolithiasis [4].

Concentrated urine excretion or low-volume urine is considered to be one of the major risk factors for stone formation [5]. High fluid intake is been the oldest traditional treatment recommended by physicians to kidney stone disease patients [6]. Fluid intake is one of the important modifiable risk factors in kidney stone disease which can be considered for preventive measures [7]. Nevertheless, various kinds of fluids cannot have the same effect on stone formation [4]. Beverages differ in their composition such as concentration of alcohol, sugar,

caffeine, and oxalate content which may have different influences on stone formation. Some fluids may show beneficiary effects whereas some fluids may act as risk factors [8]. The mechanism of the effect of various fluids in the stone formation is still controversial.

Few studies are available on different fluid intake and risk of stone formation in different demographic regions, but food and lifestyle habits vary from one demographic region to another. Recognition of very common modifiable risk factors with respect to their geographical area will help to find a newer approach towards the prevention and treatment of kidney stone diseases. There was no study conducted in the North Karnataka region on fluid intake habits and risk of stone formation, the present study aims to assess the intake of various fluids and beverages along with water in urolithiasis patients attending the urology clinic of the tertiary care centre.

## 2. MATERIAL AND METHODS

After the approval taken from our institutional review board, patients with kidney stone disease attending a urology clinic at a tertiary care centre were recruited for the study from the period August 2020 to March 2021. Patients with all age groups of both genders were included in the study. Total of 240 kidney stone patients participated in the study.

### 2.1. Baseline assessments

The present study is conducted through structured and validated questionnaires which provided basic information on their general background, place, age, sex, occupation and their brief medical history of kidney stone disease and comorbidities like diabetes, hypertension or any other disease and also on lifestyle practices, other exposures of interest, and incidence of a newly diagnosed disease. The collected information was verified by comparing it with the medical records of the patients from the urology ward of the tertiary care centre.

### 2.2. Assessment of fluid and other beverage intake

Age-matched percentage rates of renal calculi were computed across categories of consumption of each type of beverage. Among various fluids, we considered 6 different types of fluids or beverages intake along with their frequency and quantity of intake per week. Water intake was asked as a separate question with the details of intake in litres per day and the source of their drinking water. The information was collected on a validated standard food questionnaire. The questionnaire was having multiple options like never, very less (less than once in a month), less (1-2/month), moderate (1-2/ week) and more (more than once a day) and further these options were coded accordingly for analysis.

After the data collection, the descriptive statistics were calculated by using IBM SPSS (Version 22.0 Armonk NY, Chicago USA) software for summarizing patients' questionnaire responses. Categorical variables were analysed by their frequencies, and continuous variables were analysed by their mean, standard deviation, median, and range.

## 3. RESULTS

A total of 240 Kidney stone patients attending a urology clinic at a tertiary care centre were recruited in the study from the period August 2020 to March 2021. Patients were categorised into three groups according to their residence as Karnataka, Goa and Maharashtra. Out of 240 patients, 152 were male patients and 88 were females. The overall male-to-female ratio was 1.72: 1. The male-to-female ratio varied slightly according to the residence. The details are mentioned in Table 1.

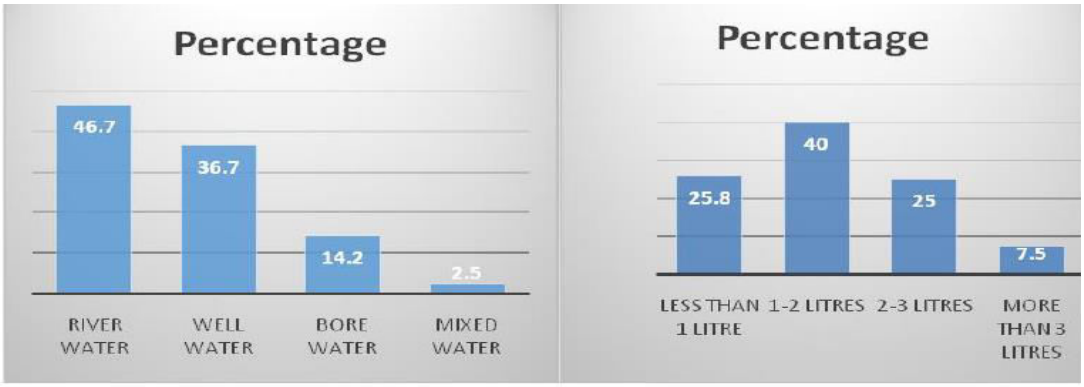


**Fig. 1: Source of water and quantity of water intake with percentage distribution of cases**

**Table 1: Male and female ratio and BMI of kidney stone patients**

| Residence | Male | | Female | | Total | | Male to female ratio | BMI(Mean) |
|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | | |
| **Karnataka** | 110 | 63.9 | 62 | 36 | 172 | 71.6 | 1.7: 1 | 26.07± 3.569 |
| **Maharashtra** | 28 | 60.8 | 18 | 39.2 | 46 | 19.16 | 1.5:1 | 25.99±2.978 |
| **Goa** | 14 | 63.6 | 8 | 36.3 | 22 | 9.16 | 1.75: 1 | 25.45±0.296 |
| **Total** | **152** | 63.3 | **88** | 36.6 | **240** | 100 | **1.72: 1** | 26.04±3.485 |

**Table 2: Age groups and BMI of kidney stone patients**

| Age distribution | | | BMI (n) | | | | |
|---|---|---|---|---|---|---|---|
| **Age group** | **'n'** | **Percentage** | **(15.1-19)** | **(19.1-25)** | **(25.1-30)** | **Above 30** | **Total** |
| **0-10** | 4 | 1.7 | 4 | 0 | 0 | 0 | 4 |
| **11-20** | 10 | 4.2 | 6 | 2 | 2 | 0 | 10 |
| **21-30** | 32 | 13.3 | 0 | 22 | 10 | 0 | 32 |
| **31-40** | 38 | 15.8 | 0 | 26 | 12 | 0 | 38 |
| **41-50** | 52 | 21.7 | 0 | 28 | 18 | 6 | 52 |
| **Above 50** | 104 | 43.3 | 0 | 32 | 58 | 14 | 104 |
| **Total** | 240 | 100.0 | 10 | 110 | 100 | 20 | 240 |
| **Mean** | 46.8375±16.16 | | | | | | |

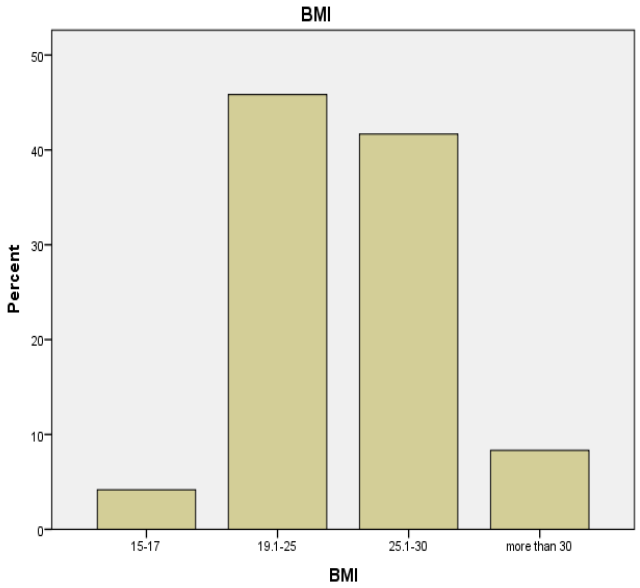


**Fig. 2: Body Mass Index (BMI) of KSD patients**

The patient's height and weight were collected and Body Mass Index (BMI) was calculated. The overall mean BMI of 240 cases was 26.04. The important observation was among 240 cases 40.7% of cases were having BMI in the range of 25.1- 30 which is considered overweight and around 8.3% of cases were having BMI of more than 30 which is considered as obese. So, among 240 cases more than 50% of the kidney stone patients were having higher BMI than normal. The details are mentioned in Fig. 2 and Table 1.

The number of patients varied in accordance with different age groups. Among all KSD patients, the highest numbers of patients were seen among those aged above 50. A total of 104 (43.3%) patients out of 240 were above 50 ages. The second highest numbers of patients (21.7%) were seen among the age group of 41-50. Out of a total of 240 KSD patients, 4 were paediatric patients aged between 0-10 years. The mean age and percentage of KSD patients in different age groups are mentioned in Table 2. Among 240 cases, 172 (71.6%) patients were from Karnataka and the second highest number was seen from Maharashtra (19.1%). Others were from Goa. The details are given in Table 1.

Further, we analysed the intake of various fluids among these patients along with water intake. The water intake was less than normal among the majority of cases *i.e.*, a total of 96 patients out of 240 used to have 1-2 litres/day, (40.8%) whereas 62 patients (25.8%) used to have less than 1 litre of water which is considered to be one of the major risk factors for urolithiasis. Along with the intake of water, we analysed the source of water in which 46.7% of patients used to consume direct tap water and 36.7% of cases used to consume bore water. The remaining 14.2% were well water consumers and 2.5% used to consume combined sources. The details are shown in Fig. 1.

Further, we analysed the intake of various kinds of fluids like tea, coffee, milk and buttermilk. As tea is the major beverage taken by this north Karnataka population, 63.3% of KSD patients used to consume more than two cups of tea every day and 25% of people used to consume twice a day. Coffee consumption was very less

in this population as 76% of people never had coffee in their diet. Milk consumption was also very less as 60% of patients used to have it only once a week and only 18.5% of patients used to have it every day. Buttermilk intake was not as significant as 31.7% never had and 8.3% used to have it every day in their diet. On average tea, consumption was more compared to all other beverages. The details of the same are mentioned in Table 3.

Alcohol and aerated cold drinks had controversial results among urolithiasis patients in most of the previous studies, in the present study intake of alcohol was almost nil in the case of females whereas among males 32.8% of males used to consume considerably high alcohol (almost every day), 22.3% used to have very less (once in a month) and 40.7% never had alcohol. Considering aerated drinks gender wise total of 50% of males and females never consumed these drinks whereas in case of remaining 50% of cases only 23.6% of the male patients and 11.3% of females used to consume high amounts (almost every day) whereas 26.3% of males and 11.3% females had moderate (twice a week) quantity of aerated drinks in their lifestyle. The details are given in Table 4.

**Table 3: Consumption of fluid in renal stone patients**

| | Never | | Less | | Moderate | | More | | Only in summer | |
|---|---|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % | n | % |
| **Milk** | 42 | 17.5 | 142 | 60.8 | 10 | 4.8 | 42 | 17.5 | - | - |
| **Tea** | 12 | 5.0 | 16 | 6.7 | 152 | 63.3 | 60 | 25 | - | - |
| **Coffee** | 182 | 76 | 40 | 16.6 | 14 | 5.8 | 4 | 1.6 | - | - |
| **Aerated drinks** | 120 | 50 | 74 | 30.8 | 20 | 8.3 | 20 | 8.3 | 6 | 2.5 |
| **Buttermilk** | 76 | 31.7 | 50 | 20.8 | 24 | 10.0 | 24 | 10.0 | 66 | 27.5 |

**Table 4: Consumption of alcohol and aerated drinks in kidney stone patients**

| Gender | Never | | Less | | Moderate | | More | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | N | % | |
| **Alcohol consumption** | | | | | | | | | |
| **Male** | 62 | 40.7 | 34 | 22.3 | 6 | 3.9 | 50 | 32.8 | 152 |
| **Female** | 88 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 88 |
| **Total** | 150 | 2.5 | 34 | 14.16 | 6 | 2.5 | 50 | 20.83 | 240 |
| **Aerated drinks consumption** | | | | | | | | | |
| **Male** | 58 | 38.1 | 18 | 11.8 | 40 | 26.3 | 36 | 23.6 | 152 |
| **Female** | 62 | 70.45 | 6 | 6.8 | 10 | 11.3 | 10 | 11.3 | 88 |
| **Total** | 120 | 50 | 74 | 30.8 | 20 | 8.3 | 26 | 10.8 | 240 |

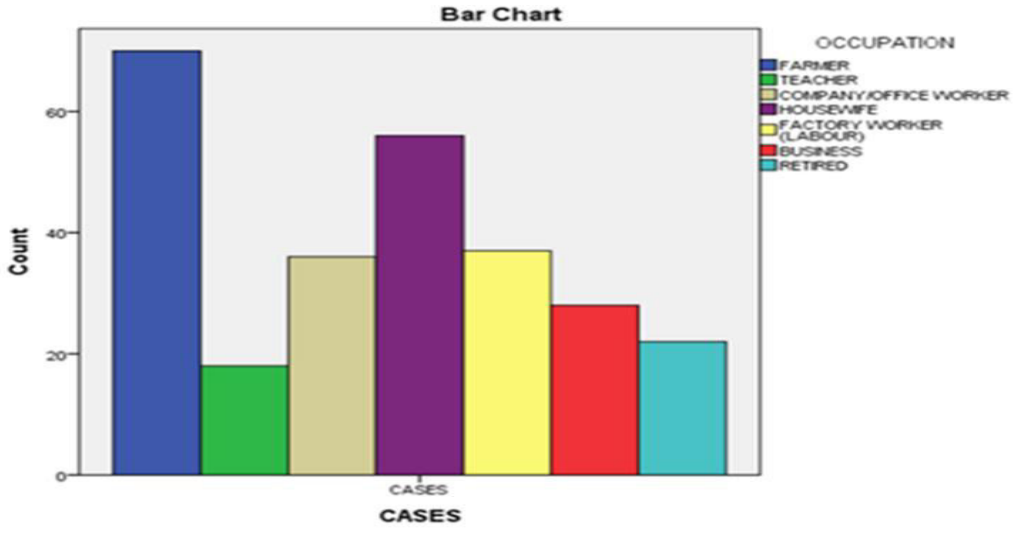


**Fig. 3: Occupation and KSD patients**

Literature suggests that occupation of people can also become one of the risk factors for urolithiasis as a few occupations may lead to dehydration which is a major cause of urolithiasis as it leads to the excretion of concentrated urine. In our study highest numbers of cases were among farmers (27.5%). The second highest cases were seen in housewives (26.7%) and around 11.7% were factory workers. The details are given in Fig. 3.

In addition to this qualitative data, we analysed all 240 stone samples for their chemical composition using FTIR spectroscopy (Fig. 4). When we categorised stone samples according to their chemical composition highest number of stone samples were pure calcium oxalate stones (58.3%). The second highest was uric acid stones (16.6%) which was a unique observation in the present study as uric acid stone formers were considerably in fewer numbers in other previous studies at different geographical regions. The details of other stone types with the percentage of cases are mentioned in Table 5.

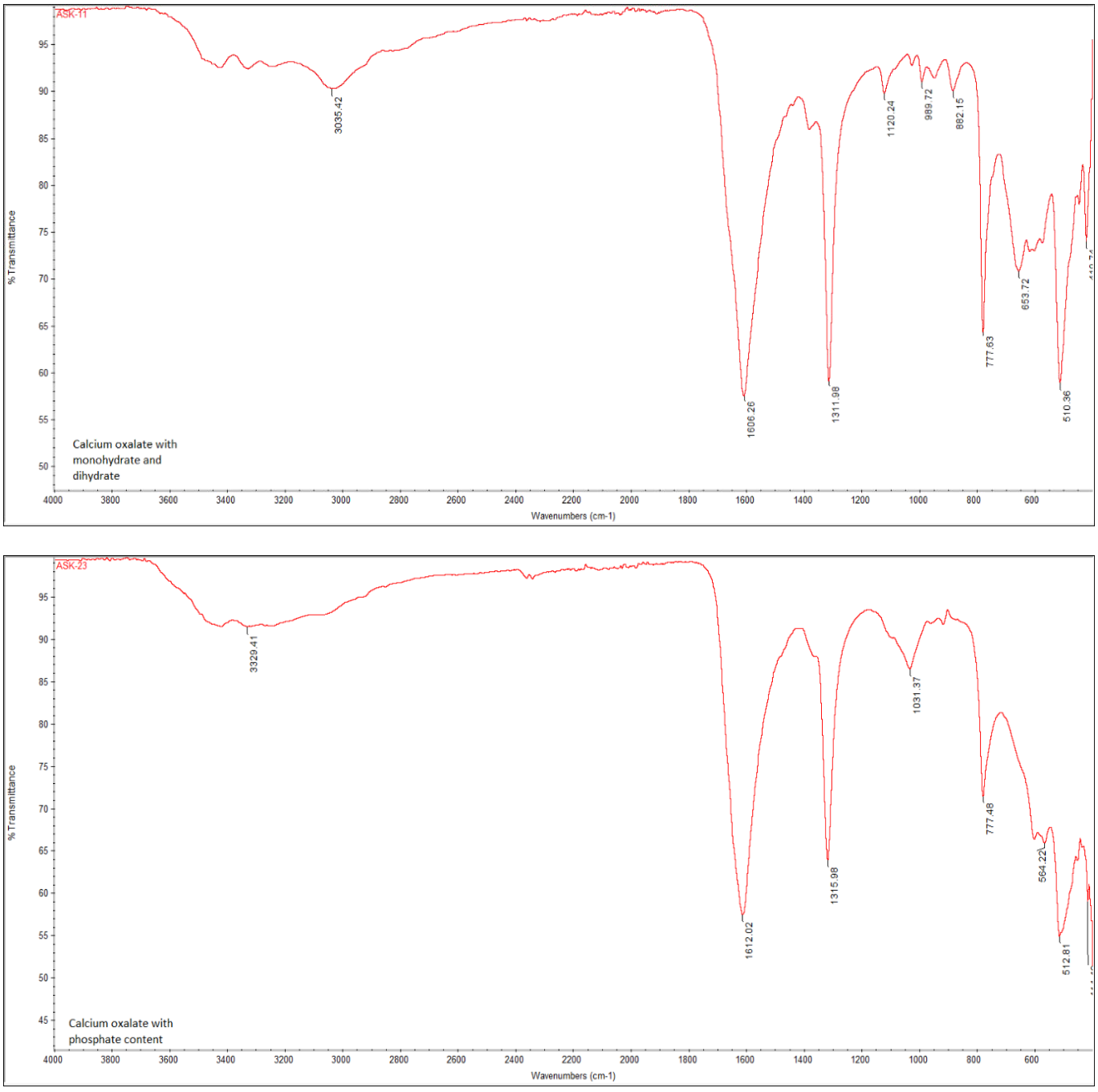


**Fig. 4: FTIR graph of calcium oxalate stone**

**Table 5: FTIR analysis of kidney stones**

| Type of the stone | 'n' |
|---|---|
| Calcium oxalate | 140 (58.3%) |
| Pure uric acid + calcium oxalate with uric acid | 40 (16.6%) |
| COM/COD+ Phosphate | 26 (10.8%) |
| Calcium oxalate with carbonate+ phosphate | 24 (10%) |
| Calcium oxalate + carbonate | 06 (2.5%) |
| Struvite stones | 2 (0.83%) |
| Mixed stones | 2 (0.83%) |
| Total | 240 |

## 4. DISCUSSION

The present study is conducted on kidney stone patients of the North Karnataka population attending the urology clinic of a tertiary care centre. In recent decades the number of KSD patients has drastically increased all over the world including this population [9]. The literature says that urolithiasis prevalence may vary in accordance with demographic features and lifestyle habits [10] and no study has been done on this population to analyse the association of major risk factors with stone formation. Among various risk factors BMI (body mass index) is considered to be one the important modifiable risk factor. A study conducted by CR Powell et al, in 2000 reports that Excess body weight increases the excretion of oxalic acid and uric acid in urine which may increase urinary supersaturation leading to crystal formation. It was more prominent in the case of women than in men [11]. Our study also supports these results as more than half of KSD patients were having excess weight with a BMI ranging between 25.1-30. The mechanism by which obesity has an association with kidney stone formation is still unclear, but the higher secretion of insulin as a result of heavy carbohydrate intake is having relation to obesity and it may become a risk for stone formation by changing urinary composition [12].

The results of the present study show that less water intake is one of the major risk factors for urolithiasis as around 60 % of KSD patients did not have an adequate amount of water in their daily routine. Along with the quantity of water intake, source water consumption also has a major effect on the stone formation as it decides the mineral content of the water which is in direct association with the stone formation. In the present study, source water did not show any significance as there was an almost equal distribution of cases among river water and well water and bore water consumption percentage was less. The present study has focused on the assessment of the intake of 6 different fluids /beverages among kidney stone patients. Milk was one of the fluids we considered to analyse as a lot of controversial studies are available on dietary intake of calcium and the formation of stones. Our study result shows that on average 25% of the patients used to consume more than adequate quantity of milk whereas in the remaining KSD patient's intake was considerably less. Reason being there was the biggest misconception was there among patients that the consumption of milk and milk-related products may increase the risk of stone formation. As the literature suggests that dietary calcium is not involved in causing urolithiasis, patients should not be restricted to take dietary calcium as it may lead to bone demineralization and may increase the risk of stone formation because of less intake of calcium. So, more studies have to be conducted in this regard to erase the misconception about dietary calcium [13].

Another important beverage consumed in a higher quantity by the north Karnataka population is tea and to some extent coffee. These two beverages are rich ina substance called as 'Caffeine' which is said to be one of the potential risk factors for calculi formation as it is involved in altering the urinary calcium and creatinine ratio [14]. A study conducted by Massey et al in 1992 reports that caffeine is moderately responsible for increasing diuresis along with the excretion of sodium, potassium, magnesium and calcium to some extent [15]. Another recent meta-analysis observational study conducted by Chang *et al.* reports that the intake of tea and coffee was associated with a reduced risk of stone formation. Dose-dependent intake and some beneficiary substance (calcium) present in tea and coffee would be responsible for the prevention of stones [2]. In our study coffee intake was very less and tea intake was considerably high as more than 50% of the patients used to consume a high quantity of tea (more than once a day) which was in accordance with a study conducted by Massey et al. Further in-depth studies have to be conducted on the mechanism of caffeine involved in the process stone formation.

In the present study, intake of carbonated soda was considerably less as more than half population never consumed carbonated soda. But among male cases, a considerable number of male patients used to consume these drinks more than twice a week and a few almost every day. According to works in literature' high intake

of artificially sweetened soda was a risk factor for the initiation of urinary stone formation because of its high fructose content, as fructose is said to be involved in increased excretion of calcium, oxalate and uric acid [4]. The study conducted by Fink *et al.* 2009 reported that a decrease in the intake of soft drinks among high consumers has reduced the risk of the formation of stones[16]. Results of the meta-analysis conducted by Chang *et al.* 2015 say that limited intake of soda was not associated with calculi formation, but the study had no data on higher intake of soda and risk of urolithiasis[16].

There is a paucity of literature which could explain the mechanism of risk of calculi formation with alcohol intake. According to our study, consumption of alcohol was almost negligible among female cases whereas among men 33% of patients used to consume alcohol almost every day. One study conducted on the diuretic action of alcohol in men reported that because of its diuretic action alcohol may be involved in the reduction of kidney stone formation [17]. Another study conducted by Curhan et al. 1970 observed a reduced risk of stone formation among high consumption of beer and wine [18], still, some controversial results are also available on alcohol intake and urolithiasis. Few studies may strongly say that alcohol reduces kidney stone formation but it's not advisable to consume it in higher quantities as it has other adverse effects on the human body.

The present study is conducted in the North Karnataka population, the dietary and lifestyle habits vary from other parts of the country which has to be focused on while studying the risk factors of stone formation. This study revealed that apart from the above-mentioned fluids the people of this belt consume another fluid in a higher quantity *i.e.,* buttermilk which is one of the milk derivatives. There are no studies available on the effect of buttermilk intake on stone formation. In the present study, 20% of the population consumed a higher quantity of buttermilk whereas as in 35% of patients' intake was high only during the summer season. It's advisable to take this fluid as it's one of the milk derivates and adds to the quantity of fluid intake and helps in diluting the urinary excretion.

Further, when we analysed the burden of stone formation in a different occupation, the percentage of KSD was highest among farmers. One of the main reasons for this could be dehydration as they work under the hot sun for more than 7-8 hours and they will be considerable water loss through sweat formation. Along with this drinking water was also less than adequate among most of the farmers. (Fig. 3) So, these could be the main reason for urolithiasis in farmers. A review study conducted by D. A. Malieckal *et al.* 2020 reports that people with less excess to rest room may end up drinking less water which could be one of the reasons for occupational kidney stone disease also people who do excess physical activity especially outdoors perspire more and excrete concentrated urine, which is clearly evidenced in the present study [19]. Still more studies have to be conducted among farmers of different demographic regions to analyse major risk factors which may help to prevent the reoccurrence of kidney stone disease.

Along with the detailed history of patients, we chemically and spectrally analysed all 240 kidney stone samples composition using FTIR spectroscopy. According to our results, the highest numbers of stones were pure calcium oxalate which was similar to most of the previous studies. The second highest type we found in our study is uric acid stones which were not common in many research works and it's a unique feature of north Karnataka. A study conducted by M. S. Ansari *et al.* 2005 in the north Indian population reports that 80% of stones were composed of calcium oxalate and the percentage of uric acid stones was only 0.95% which was contradictory to our results [20]. This clearly suggests that there will be a remarkable difference in stone composition in different geographical regions within the country itself. So, more studies have to be conducted in this regard considering the highest population to find out the exact mechanism behind the increased prevalence of uric acid stones.

## 5. CONCLUSION

In the present study intake of water was less than average in the majority of cases. Fluids like milk, fruit juices and buttermilk are shown to reduce the risk of stone formation to some extent, whereas tea and carbonated beverages may act as risk factors. Alcohol is still having controversial results in stone formation. Although increased water intake has always shown a beneficiary impact on the prevention of kidney stones, fluids other than water are not having the same effect. Various fluid intake adds to the quantity of water and may contribute to diluting the urine but the composition of these fluids will be having a direct effect on the mechanism of stone formation. So, more studies have to be conducted in different geographic regions

considering higher populations to confirm the effect of different fluids on the stone formation which may help to prevent the reoccurrence and may reduce the burden of urolithiasis.

***Conflict of interest***

Nil

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