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ORIGINAL ARTICLE

Assessment of the role of general, biochemical and family history characteristics in kidney stone formation

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KEYWORDS

Risk factors;
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Abstract *Aim:* The main objective of the study was to determine the urinary risk factors involved in kidney stone formation.

Method: In this study a total number of 101 patients (64 males and 37 females) between the age group 2 and 70 years were selected. Personal characteristics like age, family history, clinical sign and symptoms, education, monthly income, living style, smoking or tobacco chewing habit, dietary intake and daily amount of drinking water were recorded.

Results: The study showed that the risk of kidney stone formation was high in the median age group (16–25 years) both in male and female population. The most important factors associated with this were lack of drinking clean water, over weight and obesity as well as family history (37.5% and 27.02% in men and women, respectively).

Conclusion: Our study has confirmed that lack of drinking sufficient amount of water, increasing weight and obesity and family history are some major factors contributing to the increased risk of kidney stone formation. Therefore it is very important to live a healthy life, drink clean water and control weight to prevent such diseases.

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1. Introduction

The prevalence and incidence of kidney stone is a major cause of death all over the world. Life time prevalence of symptomatic nephrolithiasis is around 10% in men and 5% in women and about more than $2 billion spent each year for treatment purpose (Taylor and Curhan, 2008; Taylor et al., 2005). A number of different kinds of factors are involved in

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increasing the risk of kidney stone formation like; excess calcium, phosphate, oxalate and uric acid in the urine, inadequate hydration, lack of stone inhibitors in the urine, family history of stone (Curhan et al., 1997), daily urine volume, high, large body size (Curhan et al., 1998), some medications and ongoing urine infection (Sowers et al., 1998; Stamatelou et al., 2003; Pandeya et al., 2010; Leonetti et al., 1998). Dietary risk factors play a very vital role in stone formation. There is a proof that diminished fluid and calcium consumption is a strong risk factor (Stamatiou et al., 2006; Hirvonen et al., 1999), increased consumption of oxalate is also a major contributor to enhance the stone formation (Taylor and Curhan, 2008). It is verified by epidemiological studies that increased sodium, salt and animal proteins intake have an equivocal impact on stone formation risk (Curhan et al., 1997; Stamatelou et al., 2003). The global climate changes, which is an environmental factor also promote the rates of kidney stone disease. The broad consensus is that average global temperatures have increased Curhan et al. (1997). Common clinical conditions involving the kidney stone formation have been linked to a number of medical co morbidities including obesity (Taylor and Curhan, 2008), diabetes mellitus, hypertension (Cappuccio et al., 1990), chronic kidney disease, and cardiovascular problems (Rule et al., 2009). Stones of kidneys can be easily diagnosed with sudden onset of pain, blood excretion from urine and stones that appear on X-ray. Analyzing the stone prior to treatment is important because it helps to decide on the different options for treatment. Majority of the stones can be treated without undergoing surgery and about 90% of the stones will pass by themselves within 3–6 weeks. In these cases the only medication required is pain relief. In cases where the pain onset is severe and unbearable then hospital admission and analgesia may be required (Stamatiou et al., 2006).

The aim of the present study is to assess prevalence of kidney stone diseases in different age groups and to evaluate the association of self history of kidney stones with age, sex, history and geographical residence.

2. Materials and methods

2.1. Setting and study area

The study was conducted in the Quetta city and samples were collected from Bolan Medical Complex Hospital and Sandeman Civil Hospital, Quetta, Pakistan. Informed consent was taken from all participants. The study was approved by the local ethics committee of Balochistan University of Information Technology and Management Sciences (BUITEMS), Quetta Pakistan. A total of 101 patients (64 males and 37 females) were selected and information was taken in a detailed questionnaire. The study was performed from June 2011 to February 2012.

2.2. Sample and data collection

All the required information was collected by professional doctors and nursing staff. Questionnaire used for information which included, name, age, gender, location of patients, sign and symptoms, family history, daily amount of drinking water, source and treatment of water, and ultrasound reports. On the basis of age, patients were divided into 5 groups, 0–15, 16–25, 26–35, 36–45, 46–55 and above 55, respectively.

2.3. Blood collection and laboratory investigation

The skin was cleaned thoroughly and sterilized with 70% isopropyl alcohol swab (Kandall HealthCare, USA) and dried before withdrawing 2 ml peripheral blood by a 5 cc disposable syringe (Becton Dickinson Pak) from enrolled subjects. The blood was transferred to an ethylenediamine tetra acetic acid (EDTA) coated purple-top test tube. The blood was mixed in the test tubes with 5 complete inversions and tubes were marked with codes and immediately taken to the laboratory for investigation.

Complete blood cell (CBC) count, white blood cells (WBC), red blood cells (RBC), hemoglobin (Hb), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH)), mean corpuscular hemoglobin concentration (MCHC), (RDW) and platelets, were measured in this study.

The glucose level of each individual was carried out by using a glucometer (Accu–Check Active, Roche Company). Concentrations of urea and creatinine were estimated by the direct kit method using precipitant of Spinreact Co, Spain estimated in the sera of the samples.

2.4. Data analysis

SPSS 16 version was used for data analysis. All the results were checked by descriptive statistics. Results were expressed by mean standard and P value was used for checking significance level at <0.05. Graphs were also drawn for comparison between two groups.

3. Results

A total number of 101 kidney stone subjects were indentified in which male were 64 (63.36%) and female were 37 (36.63%).

Table 1 General characteristics of kidney stone patients.

Characteristics	Male	Female
	$N = 64$	$N = 37$
Age (years)		
1–15	16 (25%)	10 (27.02%)
16–25	24 (37.5%)	11 (29.72%)
26–35	8 (12.5%)	9 (24.32%)
36–45	5 (7.81%)	6 (16.21%)
46–55	5 (7.81%)	3 (8.10%)
56 and above	3 (4.68%)	1 (2.70%)
Family history of kidney stone		
Yes	24 (37.5)	10 (27.02)
No	40 (62.5)	27 (72.97)
Location		
Urban	32 (50%)	29 (78.37%)
Rural	29 (45.31%)	11 (29.72%)
History about disease		
Hypertension	12 (18.75%)	05 (13.51%)
CHD	08 (12.5%)	04 (10.81%)
Obesity	10 (15.62%)	7 (18.91%)

Table 1 shows that prevalence of kidney stone subjects was divided into five age groups with difference of 10 year. Results show that the median age group 16–25 was more affected from kidney stone disease. The highest number of cases was 24 (37.5%) in men and 11 (29.72) in women in this study. Table 1 also shows the difference between urban and rural population. The prevalence of kidney stone formation was the most dominant in urban area both in male (50%) and female (78.37) population. A family history of kidney stones was also found in both populations, male (37.5%) and female (27.02%), respectively. Table 2 shows the details of ultrasound report of kidney stone patients. It shows the site (left, right and bilateral), position of stone (mid, upper and lower) and size of stone. Results show that severe hydronephrosis was observed in the right kidney rather than the left in both males (60.93%) and females (48.86%). It is also observed that mid position of the kidney most affected in both men and women. The size of stone was found to be 1–2 cm in most of the cases, males (39.06%) and females (45.94%). Table 3 shows mean and standard deviation values of age, weight, BMI and hematological parameters like, white blood cells (WBC), red blood cells (RBC), hemoglobin (Hb), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH)), mean corpuscular hemoglobin concentration (MCHC), red cell distribution width (RDW) and platelets. Table 4 shows the mean and standard deviation values of urea, creatinine and glucose. The results show that all the variables were found to be in normal range. Table 5 shows the daily amount of drinking water, source of water and treatment. Results showed that majority of people affected with kidney stone used to drink less than one liter of water daily ($N = 74$, 73.26%). Source of drinking water was also divided into three categories. Results showed that high percentages of kidney stone population (68.30%) use tap water or use water without any treatment. Table 6 shows the sign and symptoms in kidney stone patients; 71.28% patients experienced pain in the back and 24.76% patients had the problem of blood in urine.

Table 2 Ultrasound results of kidney stone patients.

Number of stone	Male	Female
Site of kidney stone		
Left	22 (34.37%)	15 (40.54%)
Right	28 (43.75%)	18 (48.64%)
Bilateral	0 (0%)	5 (13.51%)
Position of kidney stone		
Mid	39 (60.93%)	24 (48.86%)
Upper	1 (1.56%)	4 (10.81%)
Lower	6 (9.37%)	5 (13.51%)
Size of kidney stone		
0–1	2 (3.12%)	1 (2.70%)
1–2 cm	25 (39.06%)	17 (45.94%)
2–3	17 (26.56%)	10 (27.02%)
3–4	5 (7.81%)	3 (8.10%)
More than 4	3 (4.68%)	0 (0%)
Number of kidney stones		
01	11 (17.18%)	I2 (32.43%)
02	4 (6.25%)	1 (2.70%)
More than 2	40 (62.5%)	22 (59.45%)

Table 3 Shows mean and standard deviation of age, WBC, HBG, HCT, MCV, MCH, MCHC, RDW.

Parameters	Mean	Standard deviation
Age (years)	38.81	14.33
Weight/kg	72.52	13.04
BMI	27.72	6.99
WBC (10^3/ul)	8.22	2.89
RBC (10^3/ul)	4.89	0.73
Hgb (g/dl)	12.74	2.16
MCV (fl)	79.40	13.93
MCH (pg)	26.49	7.07
MCHC (g/dl)	32.02	2.75
RDW (%)	38.51	12.72
PLT (10^3/ul)	296.45	124.02

Table 4 Shows the Mean and SD values of glucose, urea and creatinine.

S. no.	Variable	Mean	Standard deviation
1	Glucose	104.273	25.266
2	Urea	33.068	16.098
3	Creatinine	0.945	0.530

Table 5 Daily amount of drinking water, intake, source and treatment of water.

S. no.	Variables	$N = 101$ (%)
Daily amount of drinking water		
1	0.5 (Liter)	39 (38.61%)
2	1 (Liter)	35 (34.65%)
3	1.5 (Liter)	15 (14.85%)
4	2 (Liter) and above	12 (11.80%)
Source of drinking water		
1	Communal tap water	69 (68.31%)
2	Private Tank water	35 (34.65%)
3	Filtered bottle water	07 (6.93%)
Treatment of water		
1	Boiled water	16 (15.84%)
2	Un-Boiled water	85 (84.15%)

4. Discussion

Urolithiasis is one of the most common kidney disorders encountered in clinical practice diseases, with increasing incidence and prevalence worldwide that appears even more pronounced in industrialized countries all over the world (Coward et al., 2003). This population based study provides evidence of kidney stone formation, physical and clinical association with age, weight, BMI, history of kidney stone, hematological values, kidney function tests, urine analysis etc. This study indicates that prevalence of kidney stone increases between the age group 16 and 25 year. Cappuccio et al. (1990) reported that prevalence of kidney stone was found in both male and female population. Our results showed the same outcomes in this study. This study indicates that the prevalence of kidney stones increased with age. Formation of kidney

Table 6 Sign and symptoms of kidney stone patients.

S. no.	Sign and symptoms of kidney stone	$N = 101$ (%)
1	Pain in the back and side areas of the kidney	72 (71.28%)
2	Pain in lower abdomen	19 (18.81%)
3	Nausea	3 (2.97%)
4	Vomiting	10 (9.90%)
5	Blood in urine	24 (23.76%)

stone is also common in family history. The overall prevalence of history of kidney stone patients in this study was found to be 37.05% in men and 27.02% in women. This is supported by the study of Curhan et al. (1997). Kidney stones are also a major risk factor for coronary heart disease (Rule et al., 2010). In the present study 12 out of 101 had a history of CHD. Increasing weight gain and larger BMI also play a vital role in stone formation. Thus obesity is considered an important risk factor for stone formation. It is also associated with other diseases like CHD, hypertension and debates mellitus (Taylor et al., 2005; Hamano et al., 2005). Lack of drinking water intake plays a vital role in kidney stone formation. Less than 1 L/day intake of drinking water increases the risk of kidney stone formation (73.26%). The change in water balance salts, minerals that are found in urine plays a vital role in kidney stone formation and these stones cause trouble and block the flow of urine through kidneys. Untreated water or tap water was found to be the major cause of kidney stone (84.15%) in people. While this ratio decreased significantly with use of boiled water (15.84%) previous studies also indicated that un-boiled water is a major factor in the formation of kidney stones (Sowers et al., 1998; Pandeya et al., 2010). Hypertension is also a major factor for stone formation (Cappuccio et al., 1990). In our study the prevalence of kidney stone in hypertension patients was found to be 18.75% and 13.51% in men and women, respectively.

5. Conclusion

We conclude that the kidney stone formation is strongly associated with age, weight gained, high BMI value, hypertension, CHD, family history and obesity. Lack of sufficient amounts of water and drinking the water untreated or un-boiled seemed to be the major cause of kidney stones.

Conflict of interest

The authors declared that they have no conflict of interest.

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