Original Article

Urolithiasis: Prevalence, risk factors, and public awareness regarding dietary and lifestyle habits in Jeddah, Saudi Arabia in 2017

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Abstract

Introduction: Urolithiasis is a public health concern, yet there are limited studies in our community. This study aimed to provide a current estimate of the prevalence of urolithiasis and to evaluate the public's awareness about dietary and lifestyle habits that impact on urolithiasis among the Jeddah population in 2017.

Methods: This is an observational cross-sectional study design where a self-administered questionnaire was distributed in two major malls in Jeddah. The total number of participants was 2173, who were Saudis and non-Saudis aged 18 years and above. The questionnaire includes five sections: demographics, general information related to urolithiasis, dietary information related to urolithiasis, lifestyle habits, and medical conditions.

Results: The overall prevalence of urolithiasis was 11.2%, 48.8% of which had a family history with a first-degree relative. The odds of urolithiasis among males was 1.8 times higher than in females (odds ratio [OR] =1.8, 95% confidence interval [CI], 1.4–2.4). The median age of stone disease was 33 years (25%–75%: 26–42 years). Diabetic individuals were 3.2 times more likely to have urolithiasis when compared to nondiabetic individuals (OR = 3.2, 95% CI, 2.1–4.9). Low level of awareness was observed in this cohort group with a mean score of 37.7%; 64.1% of the population were in the low awareness level, 35.3% were in the medium level, and only 0.6% participants were in the high level of awareness.

Conclusion: This study highlights the lack of public awareness about urolithiasis and knowledge about its causation despite the high prevalence. There is a clear need to inform and educate the public on matters relating to the known risk factors associated with urolithiasis.

Keywords: Awareness, diet, kidney stones, lifestyle, urolithiasis

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INTRODUCTION

Urolithiasis is the formation of urinary calculi in the urinary system.[1] The overall probabilities of forming stones vary around the world; nevertheless, it is a public health concern worldwide.[2] In 2001, an epidemiological study performed in Riyadh, Saudi Arabia stated that the renal

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calculi were 2.5 times more common in Saudis as compared to non-Saudis working in Saudi Arabia.[3]

In 2010, the European Association of Urology had stated that the prevalence of calcium-containing calculi is higher in males, with a male-to-female ratio of 2.7:1.[4] Furthermore, individuals who experienced renal stone often have a 50% recurrence rate.[5]

Lifestyle can influence the risk of stone formation. Overweight and obese individuals were reported in a study by Siener *et al*. in 2004 to have a higher risk of developing idiopathic calcium oxalate residues in the kidney resulting in renal stone formation.[6] Furthermore, poor dietary habits such as a high salt diet, a high-protein diet, and extreme fasting could contribute to the increasing incidence of renal stones.[7] The relationship between water intake and kidney stones has been addressed by several studies as hydration, which is considered to be a major determinant of stone formation.[7]

To the best of our knowledge, there were limited researches regarding public knowledge of urolithiasis risk factors, worldwide. A study done in Hong Kong by interviewing 1010 citizens concluded that the Hong Kong population had a low prevalence of renal stones and little knowledge about preventive measures.[8] In Saudi Arabia, there was no research targeting the public's awareness of urolithiasis; however, there was a research in Riyadh which targeted physicians. It reported suboptimal knowledge and practice regarding the prevention of recurrent urinary stones.[5] Hence, this study aims to evaluate the public's knowledge about dietary and lifestyle habits which increase the risk of urolithiasis. Hopefully, complete awareness and understanding may facilitate the prevention of renal stones formation in the future.

METHODS

Study design

This is an observational, analytical cross-sectional study using a convenience sampling technique for selection of the study population to estimate the prevalence of urolithiasis and to investigate the public awareness in Jeddah, Saudi Arabia regarding the impact of dietary habits and lifestyle on urolithiasis. The research project was approved by King Abdullah International Medical Research Center, Jeddah, Saudi Arabia and the Institutional Review Board.

Study population

Data were collected by distributing questionnaires from October 2017 to November 2017 during weekends and weekdays at Red Sea Mall and Al-Andalus Mall, located north and south of Jeddah, respectively. A total of (2173) participants who were Saudis and non-Saudis aged 18 years and above were participating in this study. Ethical practices were considered by giving a consent form to participants to gain their voluntary approval before answering the questionnaires. No identifiable information was collected.

Data collection instrument

We used a self-administered, close-ended questionnaire to collect our data. The questionnaire was developed by the research team based on information from a thorough literature search. It was reviewed and validated by a urologist, an epidemiologist, and a dietitian, and it was modified according to the experts' opinions. A pilot study on 50 participants was conducted for reliability analysis, and Cronbach's alpha of 0.7 was achieved.

The questionnaire used in this study was composed of five parts. The first part is for demographic information, which includes weight and height to calculate the body mass index (BMI). Questions about age, gender, and whether or not they are working or studying in the health field were also asked under this part. The second and third part are directed toward measuring the participants' awareness about general and dietary information related to urolithiasis, respectively. Symptoms and risk factors of urolithiasis are examples of the general information, while fluid, protein, and mineral intake and their relation to the disease are examples of dietary information. The fourth part investigates lifestyle habits such as smoking. Finally, the fifth part targets medical conditions such as having type 2 diabetes, urolithiasis, or a family history of urolithiasis.

Measure of assessment

Based on 16 questions asked to measure the participants' awareness, 4 of them were multiple answer questions [Table 1]. The responses were scored from 0 to 33. A composite score in percentage was then derived by dividing each individual's score by the maximum score possible multiplied by 100. An arbitrary classification was used for awareness levels. Individuals scoring 24 or above (≥70%) were rated as having a high level of awareness; a score between 12 and 23 (41% to 69%) was rated as a medium level of awareness, and a score of 13 or less (≤40%) was rated as a low level of awareness. For bodyweight classification, BMI cutoffs values were used as recommended by the World Health Organization (WHO) which are underweight (<18.5), normal (18.5–24.9), overweight (25–29.9), obese (30–39.9), and morbidly obese (≥40).[9]

Data analysis

Data were entered and analyzed using SPSS software

Table 1: Questions used to measure the participants' awareness about urolithiasis and its weighted score

Questions	Weighted score
In your opinion, which of the following are considered symptoms of kidney stone diseases	3
If your urine color is dark, what should you do?	3
In your opinion, which of the following is considered a risk factor for kidney stones?	7
Do you think holding urine (for several time) will cause kidney stone disease?	1
Do you think weather has an effect on kidney stones?	1
Do you think the dietary habits have an impact on stones incidence?	1
Do you think there is other treatment for kidney stones rather than surgery?	1
Please use the scale below to describe the pain that kidney stone patient can experience	1
Which of the following sizes of stones would cause the greatest pain?	1
What do you think is the minimum amount of fluid to be taken each day for reducing kidney stones formation rate?	1
What do you think about protein intake in patients who suffer from kidney stones disease?	1
In your opinion, which of the dietary ingredients may predispose the formation of kidney stones?	7
Do you think restricting calcium intake is beneficial in preventing kidney stones disease?	1
Do you think increase potassium intake (banana, dates, potato, and prunes) can prevent kidney stones formation?	1
Do you think high consumption of sodium will increase the risk of kidney stones formation?	1
Do you think citrus fruits or juices (orange, lemon, grapefruit, and berries) protect against kidney stones?	1

version 22. Frequency and percentages were reported for qualitative variables, while for quantitative variables were reported mean and standard deviation if normally distributed data or median and 25th and 75th percentile if data are skewed. Chi-squared test was reported for qualitative variables, and *t*-test was used for quantitative variables. Furthermore, multiple regression analysis was performed to assess the relationship of multiple risk factors on stone diseases occurrence. $P < 0.05$ were considered significant with a confidence interval (CI) of 95%.

RESULTS

Demographics population

We distributed 2300 surveys; 2173 were included in the final analysis. Participants in this study are ranged in ages from 18 to 75 years with a median age of 29 years (IQR = 13 years). Saudi nationals represented 81% (1714) of the study population. Females also represented a larger population with a percentage of 68.9%. In terms of BMI, 128 (6%) were underweight, 841 (39.5%) were normal weight, 701 (32.9%) were overweight, 309 (14.5%) were obese, and 152 (7.1%) were morbidly obese. The prevalence of participants whose BMI were above the normal represented 54.5% of the population.

Prevalence and risk factors of urolithiasis

The prevalence of urolithiasis was 11.2% (246), and 48.8% (119/244) of them had at least one relative with urolithiasis. Thus, the odds for kidney stones formation was 1.9 times greater among participants with a family history of urolithiasis than participants without a family history (OR = 1.9, 95% CI: 1.4–2.5). Precisely, the odds for kidney stone occurrence doubled among participants who had a father with urolithiasis (OR = 2, 95% CI: 1.4–2.9), while participants reporting a maternal history of urolithiasis experienced an increased risk of kidney stones formation by 60% (OR = 1.6, 95% CI: 1.1–2.5).

From the total male participants, 15.7% (105/668) were diagnosed with kidney stones in contrast to 9.4% (139/1484) of female participants. As a result, the odds of urolithiasis among males were 1.8 times higher as compared to female respondents (OR = 1.8, 95% CI: 1.375–2.368). Prevalence of kidney stones was approximately equal among Saudis (11%) and non-Saudis (12%). The median age of stone disease was 33 years (25%–75%: 26–42 years); higher aged individuals had a proportional increase in urolithiasis as compared to younger individuals ($P < 0.001$) [Table 2].

Individuals with a higher BMI also had a higher likelihood of renal stone formation, with urolithiasis diagnosed among 19.3% of morbidly obese participants, 14% of obese participants, 11.9% of overweight participants, 9.1% of normal weight participants, and 8.6% of underweight participants [Table 3].

An increased prevalence of urolithiasis had been reported in diabetic patients; the proportion of urolithiasis was 27.2% (33/121) in patients with diabetes. Diabetic individuals were 3.2 times more likely to have urolithiasis when compared to nondiabetic individuals (OR = 3.2, 95% CI: 2.1–4.9).

The prevalence of smoking in our study population was 21.4% (463/2160). We noted that 16.2% (75/463) of the smokers were diagnosed with urolithiasis versus 10.1% (171/1697) of the nonsmokers. Cigarette smokers had an increased risk of kidney stone formation by 70% (OR = 1.7, 95% CI: 1.2–2.3), while hookah smokers had a 45% increased risk of urolithiasis (OR = 1.45, 95% CI: 1.1–1.9). 13.9% (111/800) of the total smokers were

Table 2: Risk factors associated with urolithiasis

	Unadjusted OR	95% CI	*P*
Family history	1.9	1.4-2.5	>0.001
Male gender	1.8	1.375-2.368	>0.001
DM	3.2	2.1-4.9	>0.001
Cigarette smokers	1.7	1.2-2.3	>0.001
Hookah smokers	1.45	1.1-1.9	0.006

OR: Odds ratio, CI: Confidence interval, DM: Diabetes mellitus

Table 3: The prevalence of urolithiasis among body mass index categories

	Prevalence of urolithiasis (%)	OR	95% CI	*P*
Underweight	8.6	0.94	0.486-1.827	0.861
Normal	9.1	Reference		
Overweight	11.9	1.360	0.979-1.889	0.066
Obese	14	1.6	1.091-2.425	0.016
Morbid obese	19.3	2.403	1.504-3.840	>0.001

OR, CI, and *P* values of the participants. OR: Odds ratio, CI: Confidence interval

diagnosed having urolithiasis versus 10% (135/1356) who are nonsmokers.

From the results of the bivariate analysis mentioned above, the following risk factors were added to build a regression module, using multiple regression analysis, backward technique, four different modules were evaluated and the factors included in the regression modules were age, gender, DM, BMI, hookah and cigarette smoking, and family history. The results showed that family history, age, and DM were the most significant factors ($P < 0.0001$) followed by male gender ($P = 0.003$). Surprisingly, smoking ($P = 0.1$) and BMI ($P = 0.3$) were the only factors which were not significant after adjustment.

Awareness

The mean percent score of the total population regarding their awareness about urolithiasis was 37.7% ± 10.9% (12.45/33 ± 3.6) with a maximum score of 27/33 and a minimum score of 3/33. The distribution of the participants according to their score was categorized as follows: 1279 (64.1%) were in the low awareness level, 704 (35.3%) were in the medium level, and only 11 (0.6%) participants were in the high level of awareness. In particular, the number of individuals working in the health-related field was 276 (12.7%); of the designated individuals, 3 (1.1%) had a high level of awareness, while 140 (50.7%) were moderately aware. Even among self-reported individuals with urolithiasis, only 0.9% (2/217) got a high knowledge score (≥70%). However, the mean knowledge score among participants with urolithiasis was 40% ±11.6% compared to 37% ±10% of participants who have not been diagnosed with urolithiasis. The mean knowledge scores among females (37.1 ± 11) and males (37.9 ± 10.8) were almost equal. Other comparisons showed that there was no correlation between the age and the knowledge score. Although the majority of the respondents had a low level of awareness, 83.1% of them were aware that there was a relation between dietary habits and renal stones formation.

Knowledge regarding urolithiasis risk factors was generally low. The most commonly known risk factor was "low fluid consumption," which was identified by 72.5% of respondents, followed by "daily caffeine consumption," identified by 34.40% of individuals. Approximately 20% of the participants correctly identified family history or obesity as risk factors for urolithiasis. Knowledge of the roles of diabetes and gastric bypass surgery in increasing kidney stones formation was very low, with only 11% and 3.3% of study participants reporting these as risk factors for urolithiasis, respectively.

DISCUSSION

Our study pointed out the lack of awareness about diet and lifestyle and their impact on renal stones. In this study, we found that 11.2% of individuals were diagnosed with urolithiasis. In line with a previous study, which stated that the probability of forming stones in the Saudi population was 20.1%.[10] Moreover, we found that males had almost double the risk of renal stones compared to females, which was in coherence with a study reporting that kidney stones are greater in male, with a male to female ratio of 3:1.[3]

Individuals with a family history of urolithiasis appear to be at higher risk of kidney stone formation.[11] In this study, it was reported that 50% of diagnosed participants had a direct relative previously diagnosed with urolithiasis. The previous study has found a positive association of family history with a two-fold increase in the risk of urolithiasis.[11] However, it is not the only cause, as stone formation may also be developed by environmental factors such as having the same lifestyle and dietary habits.[12]

Increases in BMI and weight can affect kidney stone formation. Taylor *et al*. found that BMI was positively associated with the risk of kidney stone formation.[13] This is similar to our study which found that the prevalence of urolithiasis was greater in obese and overweight individuals compared to normal individuals. However, Semins *et al*. have shown that once a BMI of 30 kg/m^2 is achieved, the risk of stone disease stabilizes.[14] A significant association was noted between BMI and urinary supersaturation of uric acid, which could increase the risk of uric acid stone formation.[13]

Diet has been shown to enhance urine composition, and numerous epidemiological and metabolic studies have suggested that diet contributes to the risk of kidney stones. The main dietary factor that is correlated with the risk of kidney stones is the consumption of animal protein.[15] However, only 15.8% of participants knew that kidney stone patients should restrict animal protein, while almost half replied with "I don't know" among the answer options, which partly accounts for the low total score. Reduction of animal protein has a positive association with decreased risk of the disease compared to low calcium diet without protein restriction.[12] In addition to animal protein, ingestion of high oxalate can lead to hyperoxaluria and formation of calcium oxalate stones.[16] In this study, a large proportion of participants (55.1%) had no idea about food items that increased stone formation; only a small proportion was able to pick the correct answer. It has been well-documented that weather can affect kidney stones' formation directly or indirectly. Studies in Japan, Iraq, and the United States reported a high incidence of stones formation in the summer compared to winter.[17] A direct effect is the long sunlight exposure that leads to an increased Vitamin D serum level, which may enhance intestinal calcium absorption. A previous study reported that a 53% increase in the hours of sunlight and a 2.11°C increase in temperature were associated with a 48% increase in the incidence rate of kidney stones.[17] However, an indirect effect of hot or warm climate can lead to a decrease in urine output or a scant fluid intake which may explain the increase of stones in summer. In a study of the University Hospital of Parma, it was concluded that the number of cases increased to a maximum number of 4.1 cases of renal colic per day in summer compared to winter which was 2.7 cases of renal colic per day.[18] In our study, 53% of the sample responded with "no" if the weather can increase the risk of kidney stones, which illustrates the gaps in awareness and facts on urolithiasis.

One of the most well-known mechanisms of stone formation in hyperglycemic individuals is insulin resistance. Previous studies have found that there was a positive association between diabetes mellitus (DM) and kidney stones.[19] As in this study, there was a significant relation between DM patients and an increased risk of having a kidney stone. Insulin resistance could lead to lower urinary citrate excretion through decreased ammonia production, which may explain the relation.[20] A limitation of this study is that it studied only residents who visited malls, which limited our access to the morbidly obese and elderly. Moreover, female participants exceeded the males, which could either overestimate or underestimate the reported findings in this study. Finally, we used a long questionnaire that might have affected the validity of answers.

CONCLUSION AND RECOMMENDATIONS

The study concludes that although the overall prevalence of urolithiasis in Jeddah is high, the public awareness regarding dietary and lifestyle habits is low. In addition, we found that urolithiasis is more common in males, DM patients, and individuals with a family history. Risk patterns for urolithiasis were strongly associated with smoking habits, age, and obesity. Our findings highlight the need to increase public education campaigns to increase the awareness of urolithiasis among the population in Jeddah, Saudi Arabia.

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Conflicts of interest

There are no conflicts of interest.

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