# Prevalence and Risk Factors of Urolithiasis Among the Population of Saudi Arabia: A Cross-Sectional Study

Abdullah Hussien Alghamdi, MD* Abdullah Alaryni, MD* Rayan A Qutob, MD* Abdulrahman Mohammed Alanazi, MD* Meshal Alzakari, MD** Faisal Alzkari, MD** Ziyad Alsulami, MD** Musab Alsulami, MD** Rama Abu Hassan, MD** Renad Alsuhaibani, MD**

## ABSTRACT

**Diets in the Gulf region contain three times more oxalate and less calcium than in Western countries, increasing the risk of kidney stones. This study aims to assess how well people in Saudi Arabia understand kidney stones, including their causes, symptoms, prevention, and treatment options. This is an online survey study that was conducted in Saudi Arabia between November 2024 and January 2025. The questionnaire tool examined public awareness and perception of renal stone disease: symptoms, risk factors, prevention, and treatment. Multiple logistic regression was performed to identify predictors of good knowledge. A total of 524 patients were included in the analysis. Around 7.4% of the participants reported previous history of urolithiasis. Only (181, 34.5%) had a family history of the condition. The total mean score for the sample was 9.85±2.18 out of 15, indicating a moderate level of knowledge, which was attained by 41% of the sample. Individuals working in the medical fields had significantly higher odds (odds ratio (OR) = 1.66, 95% confidence interval (CI): 1.10-2.49, p =0.015) compared to those in other occupation. Additionally, having other conditions was significantly associate with higher odds (OR = 2.62, 95% CI: 1.38-5.01, p =0.003). The findings suggest moderate public awareness of renal stone disease in Saudi Arabia, with significant gaps in recognizing risk factors and prevention strategies. Sociocultural influences, occupational background, and prior health experiences play a role in shaping knowledge, while persistent myths highlight the importance of culturally tailored education. Leveraging digital platforms, community networks, and healthcare professionals can help reduce the growing burden of urolithiasis.**

***Keywords: Kidney stone; Prevalence; Risk Factors; Urolithiasis***

## INTRODUCTION

Urolithiasis or kidney stones occur when there is an accumulation of minerals and salts inside the urinary tract which are deposits that are hard in nature[1]. In developed and oil rich countries, the prevalence of kidney stones is increasing at an alarming level[2-4]. Saudi Arabia is part of the Afro-Asian stone forming belt, which has the highest prevalence of kidney stones[5]. The prevalence of kidney stones among Saudi and non-Saudi citizens is 2.5 times higher, demonstrating the immense burden the disease has toward the country and its people[6].

Several diet and environmental factors in Saudi Arabia contribute to kidney stone formation. Diets in the Gulf region contain three times more oxalate and less calcium than in Western countries, increasing the risk of kidney stones. This leads to the over-absorption of oxalate, which increases the likelihood of forming calcium-oxalate stones. The consumption of animal protein tends to be linked with higher incidences of kidney stones, as it increases the acidity of urine and decreases citrate concentration, which together facilitate the development of the stones. In addition to food, the very hot and dry weather of Saudi Arabia also contributes to a higher risk of acquiring kidney stones[3]. In fact, increased temperatures result in dehydration causing low urine output, which is a risk factor for the formation of kidney stones[7].
Although the most common causes and the extremely high cases of kidney stones are known, many people in Saudi Arabia are still oblivious to the condition[8]. Understanding how much people know about kidney stones can help with early diagnosis and guide efforts to lower the disease burden[9]. Raising awareness about diet, hydration, and risk management could help slow the rising cases of kidney stones in Saudi Arabia[10].

This study aims to assess how well people in Saudi Arabia understand kidney stones, including their causes, symptoms, prevention, and treatment options. Finding these gaps can help create better public health campaigns for those most at risk[8]. The study will also look at how awareness varies based on demographics and socioeconomic status to identify gaps in knowledge and healthcare access. These findings will improve our understanding of kidney stones and help develop better prevention and management plans, especially in countries with high rates of the disease.

## METHODS

Study design: This is an online survey study that was conducted in Saudi Arabia between November 2024 and January 2025.
Study population and recruitment: This research utilized convenience sampling technique to recruit the targeted study population. The general public of Saudi Arabia formed the study population for this research. Inclusion criteria were respondents aged 18 years and above, living in the Kingdom of Saudi Arabia, and willing to participate in the research. There was no restriction on participants gender, place of residency, or sociodemographic characteristics.

Social media platforms such as WhatsApp, Instagram, and Facebook were utilized to invite the study participants to be involved in this study.

* Department of Internal Medicine
College of Medicine, Imam Mohammed Ibn Saud Islamic University (IMSIU)
Riyadh, Saudi Arabia. E-mail: Dr.alhomrani@gmail.com
** College of Medicine, Imam Mohammed Ibn Saud Islamic University (IMSIU)
Riyadh, Saudi Arabia.

**Table 1.** The demographic characteristics of the participants

| | | N | % |
|---|---|---|---|
| Gender | Female | 326 | 62.2% |
| | Male | 198 | 37.8% |
| Age (years) | 18-25 | 449 | 85.7% |
| | 26-35 | 28 | 5.3% |
| | 36-50 | 29 | 5.5% |
| | 51-60 | 5 | 1.0% |
| | 60 and older | 13 | 2.5% |
| Nationality | Non-Saudi | 57 | 10.9% |
| | Saudi | 467 | 89.1% |
| Education | Primary school | 2 | 0.4% |
| | High school | 143 | 27.3% |
| | Diploma | 23 | 4.4% |
| | University | 356 | 67.9% |
| Occupation | Other | 365 | 69.7% |
| | Medical field | 159 | 30.3% |
| Smoking | No | 477 | 91.0% |
| | Yes | 47 | 9.0% |
| Comorbidities | None | 420 | 80.3% |
| | Intestine-related disease | 11 | 2.1% |
| | Hyperthyroidism | 9 | 1.7% |
| | Hypertension | 13 | 2.5% |
| | Other | 48 | 9.2% |
| | Diabetes mellitus | 18 | 3.4% |
| | Gout | 4 | 0.8% |
| Previously diagnosed with urolithiasis | No | 485 | 92.6% |
| | Yes | 39 | 7.4% |
| Family history of urolithiasis | No | 343 | 65.5% |
| | Yes | 181 | 34.5% |

In the invitation letter, the study aims and objectives were highlighted. Participants who meet the inclusion criteria were invited to take part in this study.

Questionnaire tool: The questionnaire tool for this research was developed based on literature review[11,12]. The questionnaire tool was distributed in Arabic language. The questionnaire tool examined the sociodemographic characteristics such as gender, age, nationality, education, occupation, smoking, comorbidities, previously history of urolithiasis, and family history of urolithiasis. Besides, this questionnaire tool examined public awareness and perception of renal stone disease: symptoms, risk factors, prevention, and treatment. The questionnaire tool was piloted on a small number of participants before conducting the full study to check it validity.

Ethical approval: Ethical approval was obtained from the review board at Imam Mohammad Ibn Saud Islamic University to ensure that the research is conducted in accordance with ethical guidelines and standards.

Data analysis: The Statistical Package of Social Sciences (SPSS) Version 29.0 software was used to analyse the data for this research. Descriptive statistics presented as the frequency and percentage presented categorical variables. The mean and the standard deviation (SD) presented continuous variables. The Analysis of Variance (ANOVA) test and the independent t-test were performed to examine the difference in continuous variables. For multiple group comparisons, Tukey-Post hoc test was applied. The knowledge score was categorized based on the respondent's mean as a cutoff point into poor and goof knowledge (mean score for the sample was 9.85). Multiple logistic regression was performed to identify predictors of good knowledge and presented as odds ratios (OR) with 95% confidence intervals (CI) and corresponding p-values. The level of significance was defined as $\alpha = 0.05$.

## RESULTS

A total of 524 patients were included in the analysis. Most of patients (326, 62.2%) were females, while 107 patients (38.9%) were male. The majority of the participants (449, 85.7%) were aged between 18 and 25, followed by 29 patients (5.5%) aged 26 to 35. Regarding the nationality, 467 patients were citizen (89.1%, and the remaining were from other nationalities. In term of education level, a total of 356 patients had a university degree, followed by high school level (143, 27.3%). The majority of the participants (485,92.6%) had no history of urolithiasis, and only (181, 34.5%) had a family history of the condition. Additional details about patients' demographics are provided in Table 1.

Among the symptoms, 343 (65.4%) identified sharp pain in the back and sides, while 309 (58.9%) recognized a burning sensation during urination. Regarding risk factors, 429 (81.8%) acknowledged that not drinking enough fluids increases the risk, while 118 (22.5%) considered a family history as a contributing factor. When asked about prevention, 443 (84.5%) agreed that high sodium intake increases the risk, and 301 (57.4%) believed citrus fluid help prevention stones. Additionally, 401 (76.5%) thought that holding urine can contribute to stone formation. In terms of treatment, 394 (75.2%) believed that options other than surgery exist. Additional details about symptoms, risk factors, prevention, and treatment are provided in Table 2.

The total mean score for the sample was 9.85±2.18 out of 15, indicating a moderate level of knowledge, which was attained by 41% of the sample. Nationality showed a statistically difference (p=0.03), with non-Saudis a higher mean score (10.42 ± 1.96) compared to Saudi (9.78 ± 2.20). Education level approached significance (p=0.05), with university graduates scoring the highest (9.98 ± 2.10) compared to primary school (8.00 ± 2.83). Individuals in the medical field had a significantly higher mean of knowledge compared to other field of working (10.39 ± 2.03) (9.62 ± 2.21) (p =0.001), respectively.

**Table 2.** Public awareness and perception of renal stone disease: symptoms, risk factors, prevention, and treatment

| | | N | % |
|---|---|---|---|
| In your opinion, which of the following are considered symptoms of renal stone diseases? * | Sharp pain in the back and sides # | 343 | 65.4% |
| | Feeling of intense need to urinate # | 179 | 34.1% |
| | Burning feeling during urination # | 309 | 58.9% |
| | I don't know | 98 | 18.7% |
| If your urine color is dark, what should you do? * | Go to the doctor directly# | 274 | 52.2% |
| | Wait until other symptoms appear | 216 | 41.2% |
| | Take medication from the pharmacy | 37 | 7.0% |
| | I don't know | 98 | 18.7% |

| | | | |
|---|---|---|---|
| In your opinion, which of the following is considered a risk factor for renal stones? * | Family history with this disease# | 118 | 22.5% |
| | Not drinking enough fluids# | 429 | 81.8% |
| | Protein-based diets# | 139 | 26.5% |
| | weight gain# | 130 | 24.8% |
| | Gastric bypass surgery# | 62 | 11.8% |
| | hyperthyroidism# | 88 | 16.7% |
| | chronic diarrhea# | 64 | 12.2% |
| | I don't know | 83 | 15.8% |
| In your opinion, which of the dietary ingredients may predispose the formation of renal stones?* | Potatoes | 202 | 38.5% |
| | nuts# | 210 | 40.0% |
| | dark chocolate# | 106 | 20.2% |
| | eggplant | 60 | 11.4% |
| | grapefruit# | 61 | 11.6% |
| | spinach# | 59 | 11.2% |
| | beetroot# | 65 | 12.4% |
| | coffee | 296 | 56.4% |
| | lemon | 91 | 17.3% |
| Do you think holding urine (for several time) will cause renal stone disease? | No | 123 | 23.5% |
| | Yes# | 401 | 76.5% |
| Do you think weather has an effect on renal stones? | No | 333 | 63.5% |
| | Yes# | 191 | 36.5% |
| Do you think the dietary habits have an impact on stones incidence? | No | 34 | 6.5% |
| | Yes# | 490 | 93.5% |
| Do you think there is other treatment for stones rather than surgery? | No | 130 | 24.8% |
| | Yes# | 394 | 75.2% |
| Which of the following sizes of stones would cause the greatest pain? | The smallest | 185 | 35.3% |
| | The largest# | 339 | 64.7% |
| What do you think is the minimum amount of fluid to be taken each day for reducing stones formation rate? | 1 liter daily | 122 | 23.2% |
| | 2.5 liter daily# | 322 | 61.5% |
| | 4 liters daily | 80 | 15.2% |
| What do you think about protein intake in patients who suffer from stones disease? | Prevents the formation of stones | 234 | 44.7% |
| | Helps to form stones | 290 | 55.3% |
| Do you think restricting calcium intake is beneficial in preventing stones disease? | No# | 216 | 41.2% |
| | Yes | 308 | 58.8% |
| Do you think increase potassium intake (banana, dates, potato, and prunes) can prevent stones formation? | No | 182 | 34.7% |
| | Yes# | 342 | 65.3% |
| Do you think high consumption of sodium will increase the risk of stones formation? | No | 81 | 15.5% |
| | Yes# | 443 | 84.5% |
| Do you think citrus fruits or juices (orange and lemon) protect against renal stones? | No | 223 | 42.6% |
| | Yes# | 301 | 57.4% |

* Participants can choose more than one answer, summation≠100. # correct answer

**Table 3.** Knowledge level across demographic and health related factors.

| | | Mean ± Standard deviation | P value |
|---|---|---|---|
| Gender | Female | 9.97 ± 2.10 | 0.11 |
| | Male | 9.66 ± 2.32 | |
| Age (year) | 18-25 | 9.86 ± 2.20 | 0.51 |
| | 26-35 | 9.39 ± 2.67 | |
| | 36-50 | 9.86 ± 1.81 | |
| | 51-60 | 9.20 ± 2.17 | |
| | 60 and older | 10.62 ± 0.96 | |
| Nationality | Non-Saudi | 10.42 ± 1.96 | 0.03 |
| | Saudi | 9.78 ± 2.20 | |
| Education | Primary school | 8.00 ± 2.83 | 0.05 |
| | High school | 9.71 ± 2.35 | |
| | Diploma | 8.91 ± 2.27 | |
| | University | 9.98 ± 2.10 | |

| | | | |
|---|---|---|---|
| Occupation | Other | 9.62 ± 2.21 | 0.001 |
| | Medical field | 10.39 ± 2.03 | |
| Smoking | No | 9.90 ± 2.15 | 0.14 |
| | Yes | 9.40 ± 2.46 | |
| Comorbidities | None | 9.75 ± 2.20 | 0.1 |
| | Intestine-related disease | 11.09 ± 2.70 | |
| | Hyperthyroidism | 10.89 ± 2.15 | |
| | Hypertension | 9.08 ± 1.80 | |
| | Other | 10.19 ± 2.14 | |
| | Diabetes mellitus | 10.39 ± 1.65 | |
| | Gout | 10.00 ± 1.41 | |
| Diagnosed with urolithiasis | No | 9.85 ± 2.16 | 0.98 |
| | Yes | 9.85 ± 2.47 | |
| Family history of urolithiasis | No | 9.76 ± 2.31 | 0.18 |
| | Yes | 10.03 ± 1.92 | |
| Body mass index | Underweight | 9.95 ± 2.63 | 0.88 |
| | Normal | 9.78 ± 2.26 | |
| | Overweight | 9.78 ± 2.02 | |
| | Obesity I | 10.10 ± 1.92 | |
| | Obesity II | 9.92 ± 1.32 | |
| | Obesity III | 8.50 ± 0.71 | |

Individuals working in the medical fields had significantly higher odds (OR = 1.66, 95% CI: 1.10-2.49, p =0.015) compared to those in other occupation. Additionally, having other conditions was significantly associate with higher odds (OR = 2.62, 95% CI: 1.38-5.01, p =0.003). Additional details about factor associate with knowledge score are provided in Table 4.

**Table 4.** Factors associated with knowledge score

| | | OR (95% CI) | P value |
|---|---|---|---|
| Gender | Female | Reference | |
| | Male | 1.28 (0.84-1.95) | 0.244 |
| Age (years) | 18-25 | Reference | |
| | 26-35 | 1.12 (0.48-2.65) | 0.790 |
| | 36-50 | 1.47 (0.60-3.62) | 0.398 |
| | 51-60 | 1.32 (0.08-22.34) | 0.849 |
| | 60 and older | 1.98 (0.17-23.11) | 0.585 |
| Nationality | Other | Reference | |
| | Saudi | 0.72 (0.39-1.33) | 0.297 |
| Occupation | Other fields | Reference | |
| | Medical | 1.66 (1.10-2.49) | 0.015 |
| Smoking | Non smoker | Reference | |
| | Smoker | 0.65 (0.29-1.45) | 0.290 |
| Comorbidities | None | Reference | |
| | Intestine-related disease | 2.06 (0.57-7.44) | 0.272 |
| | Hyperthyroidism | 2.18 (0.44-10.84) | 0.343 |
| | Hypertension | 0.42 (0.10-1.86) | 0.255 |
| | Other | 2.62 (1.38-5.01) | 0.003 |
| | Diabetes mellitus | 0.81 (0.15-4.27) | 0.800 |
| | Gout | 0.93 (0.05-16.09) | 0.959 |
| diagnosed with urolithiasis | No | Reference | |
| | Yes | 0.76 (0.28-2.07) | 0.589 |
| Family history of urolithiasis | No | Reference | |
| | Yes | 0.96 (0.64-1.44) | 0.836 |
| Body mass index | Underweight | Reference | |
| | Normal | 0.84 (0.49-1.44) | 0.525 |
| | Overweight | 0.85 (0.46-1.56) | 0.592 |
| | Obesity I | 1.13 (0.50-2.53) | 0.775 |
| | Obesity II | 1.35 (0.38-4.80) | 0.647 |
| | Obesity III | 0.00 (0.00-0.00) | 0.999 |
| | Constant | 0.76 (0.00-0.00) | 0.486 |

## DISCUSSION

In this study, we conducted a survey including 524 participants, especially Saudi young adults, and asked about their knowledge and awareness regarding kidney stones. The test showed a moderate level of general knowledge about renal stones, but remarkable gaps in knowledge of risk factors, preventive measures and available treatment. With these findings being consistent with various regional and global trends, they also provide opportunities for more focused educational campaigns that strive to elucidate common misperceptions relating to renal stones and diseases.

The average knowledge score of 9.85 out of 15 indicates a moderate level of awareness, consistent with studies from similar settings. A 2020 Saudi study, found almost identical results (9.2/15) and similar gaps in dietary knowledge[13]. Across the world, knowledge of renal stones is poor even in endemic areas such as the United States (US) and South Asia, where misconceptions about hydration and dietary factors are abundant[14,15]. Many individuals are unaware that small changes in daily habits can greatly reduce the risk of kidney stones, stressing the need for more public health awareness programs[16,17].

Although 81.8% of the participants were aware that dehydration is a risk factor which is higher than reported global average of 60% as per a 2021 meta-analysis[18], there were many overestimated risks with little-to-no evidence, such as the risk from holding urine (76.5%). This widespread belief likely stems from the association between urinary retention and infections, which can indirectly contribute to stone formation. Many people mistakenly link bladder issues to kidney stone formation, which shows the need for clearer public health messaging[17,19]. For instance, this is part of a larger problem, when establishing health concepts cultural narratives often take priority over scientific data.

Interestingly non-Saudi participants scored higher than Saudis (10.42) vs. 9.78, p=0.03. This gap might come from relative exposure to the health-care system. Expatriates working in Saudi Arabia usually undergo compulsory health screening and may therefore be more familiar with preventive health care measures[20]. Another possible reason for this gap is that expatriates mainly work in healthcare and education thus they might have more exposure to medical information[21,22]. By contrast, cultural habits such as using herbal medicines to cure urinary symptoms may lessen evidence-based practice knowledge among Saudis[20].

For example, a 2019 study indicated that 30% of Saudi patients with chronic conditions prioritized herbal therapies over clinical advice[23]. To overcome this gap, interventions must be tailored to respect cultural traditions while drawing attention to scientific principles. More knowledge was demonstrated by the participants who worked in the medical field (10.39 vs. 9.62, p=0.001), emphasizing the importance of professional training in the sector of health literacy. This affirms that healthcare professionals, including pharmacists and nurses, are essential in educating patients. They can incorporate brief counseling on hydration and dietary habits into their routine practice. By raising awareness among healthcare providers, we ensure that accurate information is consistently communicated to the public, thereby reducing misinformation[24,25].

Patients with chronic conditions often adopt a proactive approach to learning about their health[26]. For instance, individuals with co-existing medical conditions particularly intestinal diseases had higher odds of better knowledge (OR=2.62, p=0.003). Chronic illness frequently causes patients to look for condition-specific information, and this is called as "patient-initiated learning"[27]. However, excessive exposure to medical information can lead to fragmented knowledge. Therefore, structured patient education programs are essential for improving health literacy[28].

While there's moderate overall awareness, there are crucial misunderstandings. For instance, 76.5% of patients mistakenly believed that stasis of urine helps form stones. Although anatomical problems causing urinary stasis, including strictures, are known risk factors, voluntary retention lacks definitive support[29]. This belief could be a result of linking urinary habits, like holding urine, to infections which indirectly influence stone risk[30,31]. Public campaigns must clarify this distinction to prevent unnecessary anxiety and misguided behavioral changes. Despite that dietary calcium is beneficial, taking too many calcium supplements could actually increase the risk of kidney stones[32].

Likewise, some people mistakenly linked high protein ingestion with the phenomenon of the formation of stones despite the fact that moderate protein intake is safe if not associated with low ingestion of fluids, these misconceptions are in line with the results from Iran, where the participants unnecessarily refrained from protein-rich foods by 62%[29]. Educational materials should emphasize balancing protein with adequate hydration, where on the other hand, guidelines recommend 0.8–1.0 g/kg/day protein intake for people with history of kidney stones[33].

There is a high level agreement of about (75.2%) with conservative management and treatment for smaller stones which roughly reflect a worldwide preference[34]. However, only 57.4% considered citrus fluids preventive, even though citrate has been shown to decrease the rate of calcium oxalate crystallization[35], this disparity shows regional gaps in education. The campaigns need to draw attention to the evidence-based strategies such as the 2.5L daily fluid intake (recognized by 61.5% here) and reduced sodium consumption (84.5% awareness), which can lower recurrence by 40–60%[36]. Beliefs regarding dietary calcium were also common, 58.8% thought limiting calcium would prevent stones despite guidelines recommending adequate calcium to bind intestinal oxalate thus reducing the risk of calcium oxalate stones[37]. On a more general level, in Iran participants had rejected calcium-rich foodstuffs, unintentionally increasing their risks of developing hyperoxaluria[38]. Therefore, people need to be advised that dietary calcium is beneficial, while taking too many calcium supplements could actually increase the risk of kidney stones[32]. These misconceptions stresses the need for more awareness campaigns focused on dietary interventions, as increasing citrate intake can remarkably lower recurrence rates[39], also help people differentiate the beneficial effects of dietary calcium from the potential harmful effects of calcium as supplements[40,41].

The study's predominantly young cohort (85.7% aged 18–25) reflects Saudi Arabia's demographic profile but limits insights into older adults, who face higher stone incidence[42]. Younger cohorts may not have experiential knowledge as renal stones form later in life. But their tech-savviness presents opportunities for digital interventions. A United Arab Emirates trial in 2023 showed a 35% improvement in renal health knowledge using gamified apps[43]. Partnering with social media influencers could amplify reach a strategy proven successful[44]. Gender related disparities were statistically insignificant (females: 9.97 vs. males: 9.66, p=0.11), meanwhile women are considered the custodians of the health of the family in conservative societies, so they become prime targets for education. Similar to Saudi Arabia's "Healthy Kitchen" program, workshops on renal-friendly meal preparation could empower women to shape household habits[45,46]. Education level approached significance (p=0.05), with university graduates scoring highest (9.98 ± 2.10). This fits with evidence in other studies of similar connections between education and health literacy globally[47]. However, urolithiasis is seldom included in Saudi

school curricula[11]. Incorporating renal health in science subjects, as seen in Japan, would help encourage early awareness[47]. As well as extracurricular activities, such as school hydration challenges, might drive these lessons home[48,49].

Although this study had positive implications in evaluating public knowledge of renal stone disease, there were some limitations. The cross-sectional design limits the ability to establish causal relationships between knowledge levels and specific factors. Additionally, the predominance of young, educated participants may restrict generalizability to older or less educated populations. Another limitation is that self-reported data may lead to response bias, as participants might overestimate their knowledge.

## CONCLUSION

**The findings suggest moderate public awareness of renal stone disease in Saudi Arabia, with significant gaps in recognizing risk factors and prevention strategies. Sociocultural influences, occupational background, and prior health experiences play a role in shaping knowledge, while persistent myths highlight the importance of culturally tailored education. Leveraging digital platforms, community networks, and healthcare professionals can help reduce the growing burden of urolithiasis.**

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**Competing Interest:** None

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