

Original Article

# Associated risk factors of renal stones among residents in Amman city: cross- sectional study

## Fatores de risco associados a cálculos renais entre residentes da cidade de Amã: estudo transversal

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### Abstract

Renal stones are the most common urological problem worldwide. This study aimed to assess the prevalence of renal stones in Jordanian population and to determine factors that play role in stones formation. Data from 1296 participants had been enrolled in the study during the time interval (June 2022 to June 2023). The study enrolled 243 patients were suffering from kidney stones and meet the criteria needed to complete the aim of the study; 75 patients who respond to the phone call interview, 116 patients who visited urology clinic and 52 respondents to an electronic survey. The highest percentage of stone incidence was in patients of age > 50 years and averaged 80 kg. The renal stone appeared in (36%) of hypertension, (53%) elevated uric acid and (41%) diabetic patients. As nutritional status, (83%) of patients drink water less than 2 liters per day, 42% of the patients consume large amount animal protein (meat mainly), 31% of them have meals rich in sodium chloride, while 74% eat dairy products in large quantities, only 12% eat sea food frequently, finally 81% of the patients drink tea and coffee heavily during the day. Among the family history of renal stones, 66% of calculi patients had positive family history of calculi. The average prevalence of **renal stone disease** among Jordanian residents was about 18.1%. The study results showed that smoking, physical activity, fluid intake, sodium chloride, family history, proteins and dairy products are important risk factors that are associated with renal stone development. Monitoring a healthy lifestyle and a balanced diet is important to reduce the renal stone formation in Jordanian population in Amman city.

**Keywords:** Renal stones, prevalence, renal calculi nephrolithiasis, risk factors, urolithiasis.

### Resumo

Os cálculos renais são o problema urológico mais comum em todo o mundo. Este estudo teve como objetivo avaliar a prevalência de cálculos renais na população jordaniana e determinar os fatores que desempenham papel na formação de cálculos. Dados de 1.296 participantes foram incluídos no estudo durante o período de junho de 2022 a junho de 2023. O estudo incluiu 243 pacientes que sofriam de cálculos renais e que atendiam aos critérios necessários para alcançar o objetivo do estudo; 75 pacientes que responderam à entrevista por telefone, 116 pacientes que visitaram a clínica de urologia e 52 respondentes a uma pesquisa eletrônica. A maior porcentagem de incidência de cálculos renais ocorreu em pacientes com idade > 50 anos e peso médio de 80 kg. O cálculo renal apareceu em 36% dos pacientes com hipertensão, 53% com ácido úrico elevado e 41% diabéticos. Quanto ao estado nutricional, 83% dos pacientes bebem menos de 2 litros de água por dia, 42% dos pacientes consomem grandes quantidades de proteína animal (principalmente carne), 31% fazem refeições ricas em cloreto de sódio, enquanto 74% consomem laticínios em grandes quantidades, apenas 12% comem frutos do mar com frequência, e 81% dos pacientes tomam bastante chá e café ao longo do dia. Entre o histórico familiar de cálculos renais, 66% dos pacientes com cálculos tinham histórico familiar positivo de cálculos. A prevalência média de doença de cálculo renal entre os residentes jordanianos foi de cerca de 18,1%. Os resultados do estudo mostraram que tabagismo, atividade física, ingestão de líquidos, cloreto de sódio, histórico familiar, proteínas e produtos lácteos são fatores de risco importantes associados ao desenvolvimento de cálculos renais. Monitorar um estilo de vida saudável e uma dieta balanceada é importante para reduzir a formação de cálculos renais na população jordaniana na cidade de Amã.

**Palavras-chave:** cálculos renais, prevalência, nefrolitíase, fatores de risco, urolitíase.

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## 1. Introduction

Urolithiasis is one of the most common urologic diseases worldwide with an estimated prevalence ranging from 1% to 13% in different regions across the world (Sorokin et al., 2017). They are hard deposits of minerals which are formed from dissolved minerals in the urine and usually excreted in the urethra (Sofa et al., 2016). Kidney stones considered as the third most common urinary tract problem after UTI and prostate disorders (Delfan et al., 2015). Kidney stones are classified into calcium oxalate, calcium phosphate, uric acid, Cystine struvite, and mixed stone types, depending on the material (mineral) that formed the stones. Calcium stones performed almost 70-80% of all kidney stones (Nikpay et al., 2016).

Recent evidence demonstrates that the prevalence of kidney stones is on the rise worldwide because of multitude of factors including changes in social conditions, Dietary habits and climate (Sorokin et al., 2017; Romero et al., 2010).

Risk factors related to kidney stones vary from one population to another and environmental factors have an important and significant role in their pathogenesis (Safarinejad, 2007). Salmeh and his partners 2012 found that the incidence of kidney stones can be associated with sex, race, geographic region, occupation, hot climate, positive family history, unhealthy diet (excessive intake) of caffeine, salt, dairy products, animal's proteins and fat (Salmeh et al., 2012). Other risk factors associated with kidney stones smoking, alcohol consumption, physical activity, obesity, low fluid intake, dehydration (Sofa et al., 2016), Socioeconomic status, education (Safarinejad, 2007), water quality (Basiri et al., 2011), high intake of vitamins D and C (Rafei et al., 2014), and metabolic disorders like diabetes mellitus, hypertension, chronic kidney disease and cardiovascular diseases (Romero et al., 2010).

Kidney stones disease is a costly disease because it imposes a major financial burden to the patient and society (Weinberg et al., 2014). Epidemiological evaluation of this disease and assessment of the related risk factors may help to find appropriate ways to reduce the risk of the development of renal calculi. Also, previous studies have shown that interventions in nutrition and water composition can prevent the occurrence of kidney stones (Salmeh et al., 2012; Frassetto and Kohlstadt, 2011).

Accordingly, the present study aimed to assess the prevalence of kidney stones in Amman city in Jordan and to investigate the related risk factors of the disease depending on lifestyle performance.

## 2. Methodology and Data Collection

This study is divided into two parts; the first part was done by revising the record of a urology clinic using electronic storage program (Al-hakeem). The second part was conducted by using an electronic survey that was distributed through phones calls and social media to reach the residents participating in the study in Amman -Jordan between June 2022 and June 2023. The study received 1296 participant's respond that have been screened according to inclusion and exclusion criteria (Patients younger than

18 years old, patients who have a repeated visit for the follow up were excluded from the study and patients that came for the first time to the clinic were counted). The study enrolled 243 patients were suffering from kidney stones and meet the criteria needed to complete the aim of the study. The research was conducted in accordance with the principles of the Declaration of Helsinki for medical research involving human participants and in accordance with local statutory requirements.

Ethical approval obtained prior to data collection from the Clinic Board Committee orally. Because the study has no treatment done on human objects and the research depended on data collection from electronic storage program (Al-hakeem) and an electronic survey for public.

## 3. Results

From 1296 patients had been enrolled in the survey, a total of 243 renal patients were reported suffering from renal stones; 75 patients who respond to the phone call interview, 116 patients visit the clinic and 52 from the electronic survey, with 73 females (30%) and 170 males (70%).

According to the findings and represented in Table 1, 163 patients were smokers (67%) and 80 were non-smokers (33%) for sports practicing; only 12 patients (5%) were practicing sports regularly, while 231 of them (95%) do not practice sports. Age of patients was classified into four age intervals (in year); (18-28), (29-39), (40-50) years and (<) 50) years in which the incidence was 32 patients (13%), 56 patients (23%), 46 patients (19%) and 109 patients (45%) respectively.

Patients' weight was categorized under four weight intervals in kilograms (Kg); (40-60) kg, (61-80) kg, (81-100) kg and (< 100) kg. The number of patients in both intervals (61-80) kg and (81-100) kg was too close to each other giving 95 (39%) and 97 (40%) in order, while 29 patients were more than 100 kg (12%) and 22 patients (9%) only were between 40 kg and 60 kg. According to the health status of patients, 90 (37%) were diagnosed with hypertension, 129 (53%) had high levels of uric acid, and 100 (41%) suffered from diabetes mellitus. In dietary habits, 202 (83%) of the patients drink less than 2 liters of water per day. For meat overconsumption, 102 (42%) were high-meat consumers, 75 (31%) patients have meals with high salts levels, while 180 (74%) patients eat dairy products in large amounts. Only 29 (12%) patients eat sea food frequently. According to lifestyle factors, Smoking elevated the stone incidence as 67%.

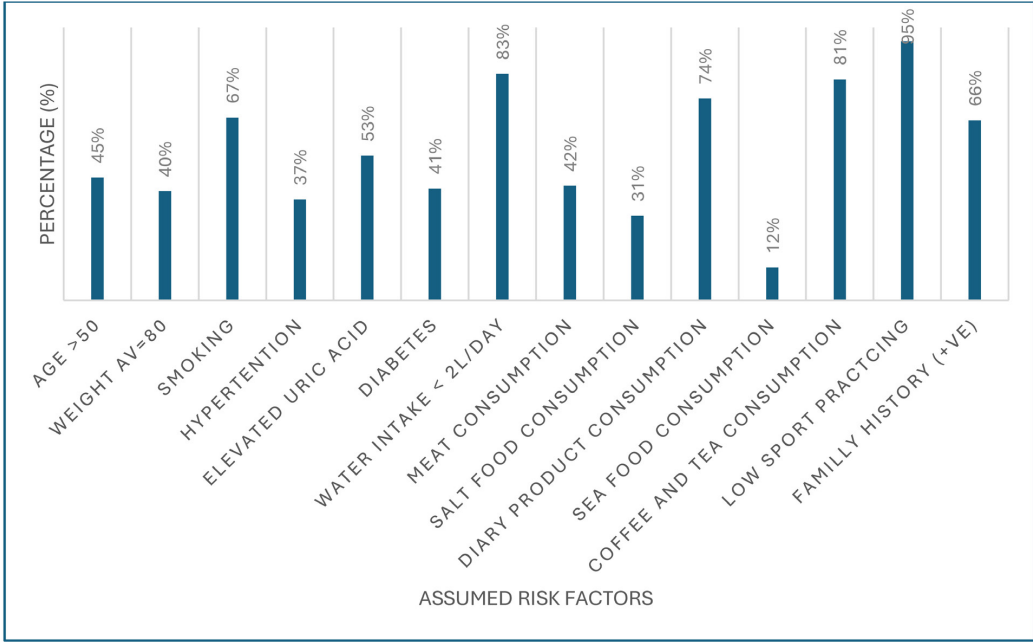
Finally, 197 (81%) patients drink tea and coffee heavily during the day. When patients were asked about their family history of renal stones; 160 (66%) had a positive family history of renal stones, 66 (27%) of them were with clear family history of stones and 17 (7%) patients didn't know whether there are renal stone patients in their family or not.

In Figure 1, the assumed risk factors were compared to reveal the most effective ones that can increase the incidence of renal stones occurrence. The results of this representative study showed that low sport practice, low water intake and high tea and coffee consumption have the highest percentage followed by high dairy product intake, smoking and positive family history.

**Table 1.** Assumed risk factors in renal stones patients counted in each point of them.

| Assumed risk factors       |                             | Numbers | Percentage* |
|----------------------------|-----------------------------|---------|-------------|
| Gender                     | males                       | 170     | 70%         |
|                            | females                     | 73      | 30%         |
| Ages (Years)               | (18-28)                     | 32      | 13%         |
|                            | (29-39)                     | 56      | 23%         |
|                            | (40-50)                     | 46      | 19%         |
|                            | (>50)                       | 109     | 45%         |
|                            |                             |         |             |
| Weight (Kg)                | (40-60)                     | 22      | 9%          |
|                            | (61-80)                     | 95      | 39%         |
|                            | (81-100)                    | 97      | 40%         |
|                            | (>100)                      | 29      | 12%         |
| Smoking                    | Smoker                      | 163     | 67%         |
|                            | Non- smoker                 | 80      | 33%         |
| Hypertension               | Positive (+ve)              | 90      | 37%         |
|                            | Negative (-ve)              | 153     | 63%         |
| Uric acid                  | Elevated                    | 129     | 53%         |
|                            | Normal                      | 97      | 40%         |
|                            | Don't know                  | 17      | 7%          |
| Diabetes                   | Diabetic                    | 100     | 41%         |
|                            | Non -Diabetic               | 143     | 59%         |
| Water intake               | >2L/day                     | 41      | 17%         |
|                            | <2L/day                     | 201     | 83%         |
| Meat consumption           | Over consumption            | 102     | 42%         |
|                            | Moderate consumption        | 141     | 58%         |
| Salt food consumption      | over consumption            | 75      | 31%         |
|                            | Moderate consumption        | 168     | 69%         |
| Dairy product consumption  | over consumption            | 180     | 74%         |
|                            | Moderate consumption        | 63      | 26%         |
| Sea food consumption       | Over consumption            | 29      | 12%         |
|                            | Moderate consumption        | 214     | 88%         |
| Coffee and tea consumption | over consumption            | 197     | 81%         |
|                            | Moderate consumption        | 46      | 19%         |
| Physical activity (sport)  | Regular & continuous        | 12      | 5%          |
|                            | Irregular & non- practicing | 231     | 95%         |
| Family history             | Positive (+ve)              | 160     | 66%         |
|                            | Negative ( - ve)            | 66      | 27%         |
|                            | Don't Know                  | 17      | 7%          |

\*Percentages are calculated referring to the total patient's number (n=243).



**Figure 1.** Percentages of renal stones patients and their assumed risk factors.

#### 4. Discussion

Urolithiasis is the most common urological problem among adults (Romero et al., 2010). The prevalence of renal stones has increased dramatically for both genders in the globe (Stamatelou and Goldfarb, 2023).

Many studies are prevalent in several countries, Ahmad et al. (2015) reported that 19.1% of patients who have visited a local clinic in Riyadh are suffering from calculi in the urinary tract. However, Safdar et al. (2021) observed among 580 responses of their electronic questionnaire, which was distributed in Saudi Arabia, that the prevalence of kidney stones was 91% and that differs from Ahmad, et al study even both studies were in the same country, Safdar et al. (2021), said this could be since Ahmad et al. (2015) study was applied on population included sick patients who have had visited the clinic with or without urological complain, in out 2-parts study we noticed the same thing , 243 renal stones patients were reported among the 1296 patients that form 18.1%.

Many factors affect the incidence of kidney stones formation such as gender, age, dietary factors, health status, general lifestyle as well as family history. Previous studies concluded that males are more susceptible to renal calculi than females (Ahmad et al., 2015; Alkhunaizi, 2016; Liu et al., 2018). A study by (Amir et al., 2018) showed a significant gender disparity in stones formation with male predominance approaching up to 79% of cases (Amir et al., 2018). In our study, percentage of males suffering from renal stones exceeded the percentage of females; (70%) and (30%) receptively. for the age of most patients with calculi were older than 50 years old (45%), while patients within 18 years old and 28 years old recorded the least frequency between the other intervals (13%), the rest of patients were within 29 years old and 50 years old here we

can say that old adults will face risk of calculi formation more than the others, and this is consistent with Worcester and Coe (2008) and Khalili et al. (2021) studies.

Poore and his colleagues 2020 suggested that obesity might be on independent risk factors for the development of nephrolithiasis. In our research, we assume the same assumption about obesity, hence patients' weight was within 60kg and 80kg (39%), and within 80 kg and 100 kg (40%), while only (12%) of patients were more than 100 kg (Poore et al., 2020).

Another observation is that 66% of the cases had a positive family history of kidney stones. Patients with urolithiasis commonly report positive family history and substantially increase the risk of renal calculi in their siblings and have higher recurrence incidence than in those without a family history of stones. Therefore, a family history of stones is considered as one of the 8 items in the stone recurrence predictive scores (Koyuncu et al., 2010).

Health status of the patient is very important when studying risk factors of a disease, in our study, hypertension, diabetes and elevated uric acid levels were key points to study. About 36% of patients were diagnosed with hypertension which might be quietly high but cannot be considered as dependent factor for renal stone formation, because nephrolithiasis generally associated with increased risk of hypertension development but not vice versa (Shang et al., 2017).

Although Taylor et al. (2005) have revealed an increased prevalence of kidney stones in diabetic patients as compared with non-diabetic patients, our study showed that diabetic renal stones patients were 54 (41%) while nondiabetics were 75 (59%). The relation of diabetes and calculi is that diabetes can increase the urine acidity which in turn increases the risk of kidney stones.

We also observed that 68 patients (53%) have high uric acid levels, 51 patients (40%) have normal uric acid levels and 9 of them (7%) haven't tested uric acid levels in their serum before. In this point, elevated uric acid levels can't be counted as a risk factor unless the patient's urine is acidic; that because in acidic urine uric acid can dissolve and crystallize in kidneys, so even patients with normal uric acid levels and acidic urine face a risk of calculi formation, so the higher uric acid levels in presence of acidic urine the higher risk of stones formation.

For dietary habits, insufficient fluid intake and diets rich in animal protein are important determinants of stone formation (Ferraro et al., 2020). In our study, 106 patients (83%) drank water less than 2 liters per day and for animal protein consumption, 54 (42%) patients consume meat in large quantities, while only 15 patients (12%) were fish consumers in large amounts.

Also, we found that 40 patients (31%) use extra salt on their meals, while 88 patients (69%) don't prefer salty food. Dietary sodium chloride intake may influence idiopathic calcium nephrolithiasis onset and recurrence. Higher salt intake has been associated with hypercalciuria and hypocitraturia which are major risk factors for calcium stone formation (Tang et al., 2024). Therefore, the 95 patients (74%) who eat meals rich in dairy products which are rich in salts and calcium are at greater risk of calculi formation.

Although patients that drink tea and coffee represented 81% (104) of the total patients, this point can't be a dependent risk factor, because it is a common habit in our community and widely distributed among the Jordanian population. Barghouthy et al. (2021) proved in his study that there is no evidence that moderate consumption of coffee raises the risk for stone formation in healthy individuals, provided the recommended daily fluid intake is maintained. Interestingly, Siener and Hesse (2021) found in their study that urinary citrate excretion – an important inhibitor of calcium stone formation – increased significantly after the ingestion of black tea.

To discuss the influence of general lifestyle on stone formation, we found that 86 patients (67%) are smokers. Many studies were performed in this topic, Mooser et al. (1989) reported that significant increase in plasma arginine vasopressin levels were associated with cigarette smoking. Therefore, cigarette smoking may further decrease urinary output which may be a potential trigger for stone formation. On the other hand, smoking can increase production of reactive oxygen species and oxidative stress in the kidney leading to renal injury (Obata et al., 2000), these injuries increase the nucleation, aggregation and retention of crystals in the kidney thereby promoting stone formation (Khan, 2005, 2006).

As we mentioned before, renal stone prevalence is greater in males than females. Since smoking tends to be more common in males, this may be one of the answers for why calculi are at higher rate in males than females (Tamadon et al., 2013).

Another important point about lifestyle that we covered in our research is physical activity, we observed that people who are practicing sports regularly are at lower risk of renal stones development, only 5% (7 patients) were practicing sports regularly, while the rest of the patients were whether practicing rarely or never play sports at all. Feng et al. (2020)

found that physical activity is inversely associated with the prevalence of kidney stones. So, incorporation of our observation and Feng, et al. 2020 conclusion, we expressed that regular physical activity would decrease the risk of stones formation.

## 5. Conclusion

In our study we found that the average of renal stones prevalence in the population is about 18.1% where males are more susceptible to suffer from the disease than females. From our results it can be concluded that smoking, physical activity, fluid intake, sodium chloride, family history, proteins and dairy products are important risk factors that are associated with renal stone development in Jordanian population in Amman. Monitoring a healthy lifestyle and a balanced diet is important to reduce the renal stone formation.

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## Data Availability Statement

The research data are only available upon request to the corresponding author.

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