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*Original article*

# Assessment of kidney stone disease prevalence in a teaching hospital

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**KEYWORDS**
Kidney stones;
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**Abstract**

*Introduction:* Kidney stones can be formed by the precipitation or crystallization of minerals and urinary constituents. It is a common problem worldwide manifested with recurrent intermittent pain episodes, surgical interventions, medication consumption which affect the quality of life of the patients.

*Objectives:* This study aimed to assess the prevalence of kidney stone disease among patients admitted to Hospital Universiti Sains Malaysia (HUSM). Also, to determine the characteristics of stones, sociodemographic, and comorbid conditions.

*Subjects and methods:* The study was a retrospective cross-sectional study design. A list of all patients admitted to HUSM for five years (January 1st, 2012 to December 31st, 2016) was retrieved. The statistical analysis included the calculation of descriptive statistics, Kolmogorov–Smirnov test of normality, and Mann–Whitney U test to compare medians.

*Results:* The prevalence of patients with kidney stones disease was 1.8% among patients admitted to HUSM. Male patients were more than females with a ratio of 1.35:1, the majority of patients were of Malay ethnicity (91.1%, n = 133). There was poor documentation about the physicochemical properties of the kidney stones. The treatment of kidney stones was individualized between patients according to their cases, shockwave lithotripsy was the most prevalent mode of treatment among patients (45%, n = 67).

*Conclusions:* Future national studies are needed to better assess the scope of the disease epidemiological measures, and to determine kidney stone formation pattern in the Malaysian population. As healthcare provision that copes with the significance of the disease will assure better outcomes.



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## Introduction

A Kidney stone, or calculi, can be formed by the precipitation or crystallization of minerals and urinary constituents such as calcium oxalate, calcium phosphate, cystine or uric acid in the kidney. Urolithiasis is a common problem worldwide with remarkable health and economic burden. It is regarded as a common cause of morbidity. After urinary tract infections and prostate diseases, kidney stone disease is considered as the third most common disease in urology [1,2].

Therapy for urolithiasis has undergone many changes. The advent of non-invasive and minimal-invasive procedures has revolutionized the surgical approach to kidney stones treatment [3]. However, the mode of treatment is individualized from patient to patient, as it depends on a variety of factors such as stone location, stone size, stone physicochemical properties, and patient's preferences.

Renal colic is the acute cramping and intermittent abdominal and flank pain caused by kidney stones. The increased wall tension caused by urinary flow obstruction together with the contraction of the ureteral smooth muscle in an attempt to move the stone stimulates the synthesis of prostaglandins. This will cause inflammation, edema formation, and the painful spasms [4–7].

Although it is not a mortal disease, kidney stone disease is a devastating disease, the recurrent intermittent pain episodes, surgical interventions, medication consumption and facing the risk of side effects, all of which affect the quality of life of the patients [8,9].

Sreenevasan G. presented the incidence of kidney stones in Malaysia by comparing between a study conducted at 1980 covered years of 1962–1976 and a study conducted at 1989 covered the period 1977–1981 [10,11]. It studied ethnicity, sex, and age distribution of kidney stones among the three major races (Chinese, Malay, and Indians). It concluded that there was no significant variation consistent with Malaysia population. Of more than four thousand diverse subjects with kidney stones; ∼37% were Malay, while ∼48% were Chinese, and around 13% Indian. From the point of age distribution, in all ethnic groups, the highest incidence found to be between the ages of 30–50 and domination of male to female ratio. Alatab et al. published a review using the same references showing that the incidence of urolithiasis had a steady increase, although it presented the only incidence of kidney and ureter stones without showing the incidence of stones in other parts of renal tracts.

This study aimed to give insight on the epidemiological aspects of kidney stones in Malaysia by determining the prevalence of kidney stones disease among patients admitted to Hospital Universiti Sains Malaysia (HUSM) in the period of 1st January 2012 to 31st December 2016. Also, to determine the characteristics of stones, sociodemographic, and comorbid conditions that are involved with kidney stone patients in HUSM.

## Subjects and methods

A retrospective cross-sectional study design was conducted. Medical records review (MRR), also known as retrospective chart review (RCR), is a type of research design depends on the already presented information in medical records that are not documented for research purposes. In general, it exists either as electronic medical records or paper-based files. However, in HUSM, the documentation method is paper-based except for lab investigations exists in electronic form [12].

The study population was all patients diagnosed and registered as kidney stones disease patient in medical records of a tertiary care center of North-East Peninsular Malaysia, HUSM.

A list of all patients admitted to HUSM for five years (January 1$^{st,}$ 2012 to December 31$^{st,}$ 2016) was retrieved. A total number of admissions to HUSM in the specified period of time was 199,318 admissions. The total number of patients above 18 years old admitted to HUSM was 86,039 patients.

In order to calculate the prevalence of kidney stones disease among the patients admitted to HUSM, steps start with collecting a random sample from them and differentiate between kidney stones disease patients and non-kidney stones disease patients as shown in Fig. 1.

Review of studies related to kidney stones disease in the Asian countries neighboring to Malaysia and the stone-forming belt was done. Based on epidemiological reports in these studies, the study assumed that the expected prevalence will be around 10%. The current study will use a confidence level of 95% with an acceptable margin of error of 1%.

The study including in the kidney stone group only those who were admitted to hospital with a stone during the period of study, patients who previously had a history of stones but did not have a stone episode during the period of study were not included.

Patients who passed stones spontaneously were considered for inclusion in the study, the study was not limited to those who had to be hospitalized to remove their stones.

Sample size calculation was done by using Epi Info™ Calculator for a descriptive study/population survey. Epi Info™ is a data collection, management, analysis, visualization, and reporting software for public health professionals. Epi Info™ is a trademark of the Centers for Disease Control and Prevention (CDC). The software is in the public domain and freely available for use, copying translation and distribution. After applying the inputs, the needed sample size is 3324 patients.

Simple random sampling was chosen to select patients. Of the list generated by medical records office for all patients admitted to HUSM, each patient given a number between 1 and 86,039. Then, the list was sorted according to (Medical Record Number), which was a step that will mix and scatter the records before the actual randomization step. Using the computer software (Research Randomizer) to generate random numbers in order to randomly select the representative sample of medical records out of the whole population of patients admitted to HUSM. Subsequently, a simple random sample of 3324 patients was obtained.

In order to differentiate between patients with kidney stones disease and normal patients of the generated random sample of patients, a list of the patients retrieved from the medical record office department in HUSM. HUSM has software that uses international classification of disease "ICD-10 Version: 2010, WHO" as a coding system for each patient according to diagnosis. The researcher chose all keywords that are relevant to kidney stones disease (N20; N21; N22; N23) for

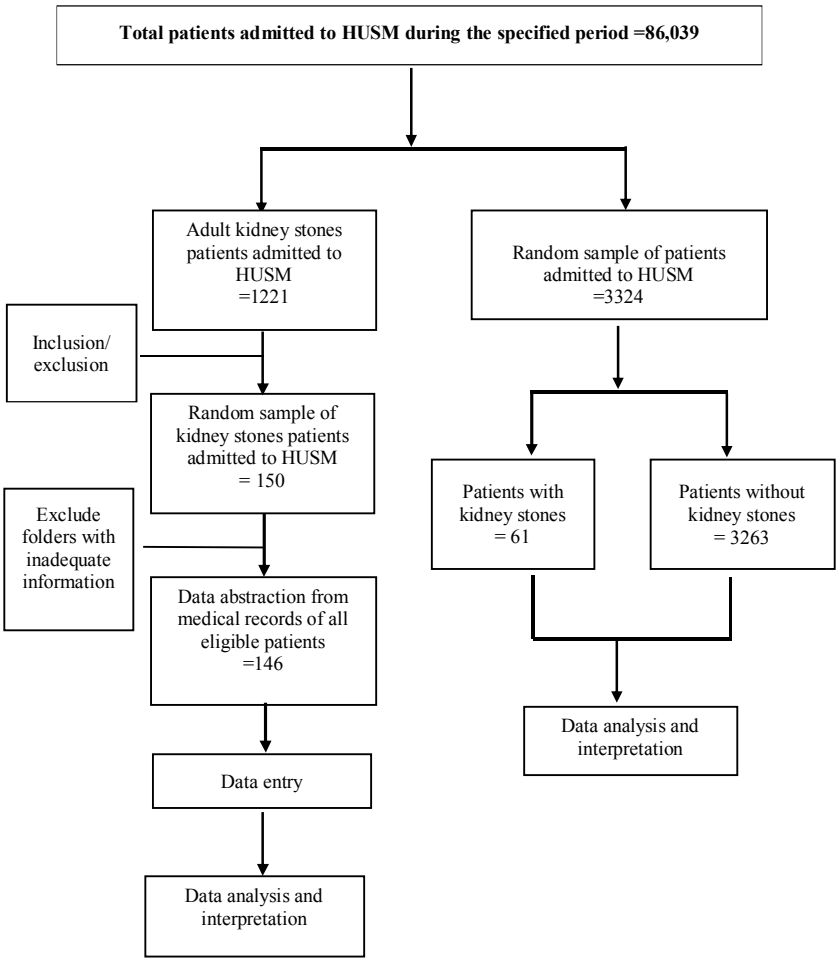


**Figure 1** Study flow chart.

the patients above 18 years old who have been admitted to HUSM within the last 5 years. 1st January 2012 to 31st December 2016.

To abstract data from the medical records, a representative sample was required. To yield a representative sample for a known proportion, the Equation (1) by Cochran (1963:75) is recommended. Where Z is a constant for each confidence of level, P is the expected prevalence or proportion, and d is the margin of error [13].

$$n_0 = \frac{Z^2 P\,(1-P)}{d^2}$$

By applying Eq. (1) to the study design, Z equals 1.96, P is 10% and d is 5%.

$$n_0 = \frac{1.96^2 0.1\,(1-0.1)}{0.05^2} = 138$$

However, for a finite population where the population is small in size, correction to the formula is applied. Eq. (2) shows the formula needed to calculate the sample size for such population. Where $n_0$ is the sample size and N is the population size.

$$n = \frac{n_0}{1 + \frac{(n_0-1)}{N}}$$

By applying Eq. (2) to the study design:

N is the population size, the population is the patients that have kidney stones disease in HUSM, a full list of patients diagnosed with kidney stones disease was retrieved from the medical records office in HUSM following ICD-10 codes for the period between January-2012 until December 2016. There were **1221 patients** tagged with codes related to kidney stones disease codes which indicates that they were diagnosed with kidney stone disease.

$$n = \frac{138}{1 + \frac{(138-1)}{1221}} = 125$$

Hence, 125 medical records were a minimum requirement to be randomly selected from the 1221 patients to abstract data from them.

**Table 1** Relationship between days of admission and history of kidney stones disease.

| | | Total days of admission | |
|---|---|---|---|
| | | Mean ± SD | Median (max–min) |
| History of kidney stones | No | 4.17 ± 4.498 | 3 (1–28) |
| | Yes | 8.06 ± 10.933 | 5 (1–79) |

Of note, 20% of medical records were added to compensate for any missing or inadequate information, 150 records needed to be randomly selected.

The obtained list of patients with the kidney stones disease was given numbers from 1 to 1221, then the list was sorted by (Medical Record Number) and using the computer software (Research Randomizer) to generate 150 random numbers.

After collecting the generated random number of patients, the medical record folders were retrieved of each random subject and data abstraction was done.

## Results

Of the random sample 3324, it was found that only 61 patients were diagnosed with kidney stones. In order to calculate the prevalence, the following equation applied:

$$Prevalence = \frac{all\ new\ and\ preexisting\ cases\ during\ a\ given\ time\ period}{Population\ during\ the\ time\ period} \times 100 = \frac{61}{3324} \times 100 = 1.8\%$$

The prevalence of patients with kidney stones disease is 1.8% in among patients admitted to HUSM between the years 2012 and 2016.

Of the medical records, male patients were more than females with a ratio of 1.35:1, they ranged in age between 22 and 99 years with a mean of 55.9 (±15.3), most of them were married. Majority of patients were of Malay ethnicity (91.1%), followed by Chinese with a much lower percentage.

Total days of admission were between 1 day and 74 days, with a mean of 6.8 (±9.548) days. Patients with a history of kidney stones disease tend to have higher days of admission compared to patients came for the first time, Table 1 shows the relationship between days of admission and history of kidney stones disease.

Information about socio-demographic including age, gender, marital status, ethnicity, smoking, weight, height, blood group, education, nutrition, work was meant to be abstracted. Noticeably, there was lack of information about weight, height, blood group, education, nutrition, and work of patients (Table 2).

Medical records were reviewed thoroughly to retrieve the details about characteristics of kidney stones that the patients had, as shown in Table 3. There was poor documentation about the physicochemical properties of the kidney stones, no testing or reporting for the composition or chemical properties of stones. Reports of medical imaging were reviewed in order to find out the radiopaque stones and radiolucent stones.

**Table 2** Socio-demographic details of patients.

| | | Frequency | Percent |
|---|---|---|---|
| Gender | Male | 84 | 57.5% |
| | Female | 62 | 42.5% |
| Race | Malay | 133 | 91.1% |
| | Chinese | 8 | 5.5% |
| | Other | 5 | 3.4% |
| Marital status | Married | 132 | 90.4% |
| | Single | 12 | 8.2% |
| | Widowed | 2 | 1.4% |
| Smoking | Yes | 21 | 14.4% |
| | No | 103 | 70.5% |
| | Ex-smoker | 22 | 15.1% |

Most of the patients suffered from a single stone only, while 10.3% of patients (n = 15) had staghorn stones. Patients with multiple stones were (43.2%).

With such uncomprehensive documentation, the current study considered radiopaque stones as calcium-containing stones as shown in the medical imaging report even if not documented by the physician as calcium stone. While radiolucent stones were not considered as uric acid only, documentation of uric acid stones was as per reporting by the physician. In term of kidney stones size, there was inadequate information as most of the patient's record did not have reports of stone size. For patients with known stone size, the mean was 2 cm (±1.75) with a range of 0.2 cm–10 cm.

Past medical history as reported in the charts were used as a source of on comorbid conditions, Table 4 shows disease comorbidities. Reporting of hypertension was as a documentation of hypertension diagnosis by a physician or the use of antihypertensive medications. Also, reporting of diabetes was as a documentation of diabetes diagnosis by a physician or the use of antidiabetic medications. However, results of lab testing indices such as HbA1c were not considered because of no reporting or testing of such lab indices. Moreover, lipid profile testing was not undertaken to vast the majority of the patient, hence, it was not considered for dyslipidemia reporting, the study relied on the documentation of the physician and the review of medication list. One-third of male patients (n = 27/84)

**Table 3** Kidney stones characteristics.

| | | Frequency | Percent |
|---|---|---|---|
| Count | Single | 83 | 56.8% |
| | Multiple | 63 | 43.2% |
| Location | Kidney | 73 | 50.0% |
| | Ureter | 43 | 29.5% |
| | Bladder/urethra | 35 | 24.0% |
| | VUJ/PUJ | 20 | 13.7% |
| Type | Unknown | 16 | 10.9% |
| | Uric acid | 24 | 16.4% |
| | Calcium | 106 | 72.6% |
| Radiology | Radiolucent | 40 | 27.4% |
| | Radiopaque | 106 | 72.6% |

**Table 4** Disease comorbidities.

| | | Frequency | Percent |
|---|---|---|---|
| DM | No | 103 | 70.5% |
| | Yes | 43 | 29.5% |
| HTN | No | 82 | 56.2% |
| | Yes | 64 | 43.8% |
| BPH | No | 119 | 81.5% |
| | Yes | 27 | 18.5% |
| IHD | No | 128 | 87.7% |
| | Yes | 18 | 12.3% |
| Dyslipidemia | No | 130 | 89.0% |
| | Yes | 16 | 11.0% |
| Gout | No | 139 | 95.25% |
| | Yes | 7 | 4.8% |
| Other | No | 128 | 87.7% |
| | Yes | 18 | 12.3% |
| None | No | 93 | 63.7% |
| | Yes | 53 | 36.3% |

suffered from benign prostatic hyperplasia (BPH), 88.9% of males who had BPH had bladder/urethra stones ($p < 0.05$). Also, although gout was not commonly prevalent, having gout was not correlated with developing uric acid stones in this group of patients.

## Discussion

The current study aimed to capture the scope of kidney stones disease problem in Malaysia through studying the prevalence of the disease and understanding the factors that may be associated with its formation of the disease, and comorbid conditions. Moreover, the study evaluated the prevailing treatment methods and management strategies of kidney stones disease employed by physicians. Also, renal function progression.

A random sample of 146 patients was included in the study from a teaching hospital in the state of Kelantan, Malaysia, retrospective chart reviews were done to collect the necessary data to achieve the objectives of the study. While another analysis of the 3324-random sample was undertaken to assess the prevalence of the disease.

This research studied the epidemiology of kidney stone disease by employing analytical measures to calculate the prevalence of the disease in a teaching hospital in the state of Kelantan in Malaysia. The findings showed that 1.8% of patients admitted to the Hospital Universiti Sains Malaysia are kidney stones patients in the period of 1st January 2012 to 31st December 2016. However, the admission was 1.72% as kidney stones patients of the whole admissions to the hospital.

This is a lower percentage than the percentages of the neighboring countries. Although the results cannot be compared to Malaysian previous data as the old data is incidence results.

As the results were obtained through retrospective screening of the medical records of that period, incidence cannot be measured. Kidney stones disease in Malaysia is almost a neglected disease where no studies are being done for it or any guidelines development. The latest study was published in 1990 which was a review of two studies done in the past.

Unlike the current study, the previous studies calculated the incidence of the disease and it was national study. Relatively, the prevalence of the disease in this area is small [14] Studying the epidemiology of kidney stones will expand understanding of the disease, numerous risk factors contribute to the risk of disease formation [15].

Studies have shown that sex and age are contributing factors, where male have higher tendency to form kidney stones than female. This coincides with the findings of the current study where male to female ratio was 1.35:1 (57.5% male, 42.5% female).

The obesity and increased weight were linked to kidney stones formation [16]. However, the current study was not able to measure the body mass index of the patients because of the poor documentation, where no height or weight has been written for patients.

The residents of the state of Kelantan are the majority of Malay ethnicity, which is why there was 91.1% Malay patients. This can explain the relatively low prevalence of the disease as studies have suggested that Asian ethnicity is the lower risk to develop kidney stones compared to white and Hispanic. Previous studies were able to link kidney stone disease with various medical comorbidities, such as cardiovascular disease, diabetes mellitus [17], and chronic kidney disease [8,18].

The patients in the current study suffered from diabetes mellitus, hypertension, dyslipidemia, among other conditions as well. Kidney stones patients with benign prostatic hyperplasia were significantly higher to have bladder stones than patients who do not have BPH. For instance, gout was correlated with patients who have uric acid kidney stones. This may be attributed to the underreporting of uric acid stones where the results cannot be relied upon.

The current epidemiological results of kidney stones disease are based on hospital records, patients admitted to the hospital. In which patients visited the emergency department are not included, patients visited out-patient clinic were not included. This is because the HUSM system has no records for these patients which limited the results of the current study.

This study is a retrospective study and as a limitation of all retrospective studies their data can be considered as inadequate data since it was not to be documented for research purposes. Clinical data such as weight, height, lab tests, stone composition, and stones' physicochemical properties were not available. Furthermore, because the stones were not analyzed on a routine basis, no data on stone analysis were included. However, knowledge of stone analysis in Malaysia would be extremely useful for epidemiologists in the field which is an open field for further research in the future.

## Conclusions

Kidney stones can be formed by the precipitation or crystallization of minerals and urinary constituents. It is a common problem worldwide manifested with recurrent intermittent pain episodes, surgical interventions, medication consumption which affect the quality of life of the patients.

Kidney stones disease was relatively not a highly prevalent among patients in HUSM with a prevalence of 1.8% in the period of 2012–2016. Future national studies are needed to better assess the

scope of the disease epidemiological measures and to determine kidney stone formation pattern in Malaysian population as healthcare provision that copes with the significance of the disease will assure better outcomes.

## Conflict of interests

The authors have no conflicts of interest to be declared.

## Ethical committee approval

The research applied for ethical approval from Jawatankuasa Etika Penyelidikan (Manusia) of USM (JEPeM) under the JEPeM code: (USM/JEPeM/17030189). JEPeM approved the research after a meeting with the researcher to discuss the research objectives and methodology.

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## Authors' contributions

Ahmed I. Nouri — data collection, data analysis, reports writing; Mohamed Azmi Hassali — Research advisor, review.

## Consent from the patient

The study is a retrospective epidemiological research, no consent from patient is required.

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