

Management of nephrolithiasis in the Middle East over a recent decade: A systematic review

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Abstract

Nephrolithiasis is a prevalent issue around the globe, particularly in hot climates such as Saudi Arabia. This analysis's objectives were to investigate the characteristics of kidney stones in Eastern Saudi Arabia and to provide the following findings: urinary stone composition, gender and age distribution, seasonal variations in stone formation, coexisting diseases linked to stone development, and urinary stone incidence. With comparisons to European and American populations, the primary risk factors for nephrolithiasis in Asian populations are to be determined through this systematic review and meta-analysis. We synthesized data from 13 geographically different studies using a thorough literature search through PubMed, ScienceDirect, and ResearchGate following the Preferred Reporting Items of Systematic Reviews and Meta-Analyses criteria. Potential targets for specialized public health programs were highlighted by the elucidation of differences in health-care-seeking behavior and disparities in health-care access. The results of this systematic analysis give doctors, researchers, and policymakers a thorough understanding of the condition of nephrolithiasis care in Saudi Arabia today. In addition, to maximize the care of nephrolithiasis in this particular group, this review identifies information gaps and highlights the necessity of context-specific guidelines and future research initiatives. All things considered, this systematic review addresses the unique possibilities and problems that exist within the Saudi Arabian health-care sector while also adding to the worldwide conversation on nephrolithiasis.

Keywords: Meta-analysis, nephrolithiasis, urinary stone

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INTRODUCTION

Urolithiasis is a recurrent multifactorial ailment caused by a combination of genetic and environmental factors. It is believed to be the adult urological disorder with the highest prevalence.^[1] Over the past few decades, the frequency has increased across all age groups, genders, and races.^[2] Numerous risk factors, including age, gender, ethnicity, local environment, dietary habits, physical activity, and

employment, might result in urolithiasis. The existence of coexisting medical disorders, such as diabetes, hypertension, and obesity, is a significant additional factor.^[3,4] Regional differences exist in the risk of kidney stones developing (It is feasible to consider geographical variation in the likelihood of developing stone diseases, such as kidney stones. These variations are typically attributed to environmental risk factors. For instance, in hot and arid regions, there may

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be an elevated prevalence of stone disease). According to estimates, Saudi Arabia, Europe, Asia, and North America account for 1%–5%, 5%–9%, 3%, and 20% of the total.^[5,6] The final part of the 20th century has seen an increase in kidney stone occurrence worldwide among both sexes,^[7] which may be related to environmental variables including nutrition and lifestyle.^[8] Nonetheless, this tendency may be partially explained by the advancement of diagnostic techniques for asymptomatic stones.^[9]

Men are more likely than women to have kidney stones, which become more prevalent with age.^[10] In addition, consuming more water, fruits, and vegetables lowers the chance of kidney stones. Kidney stone risk is decreased by sodium reduction.^[2]

Nephrolithiasis frequently manifests as renal colic, which is excruciating pain from stone passage. The stone moves from the renal pelvis into the ureter, causing ureteral spasm and perhaps blockage. As the stone descends the ureter, pain begins in the flank and spreads lower and anteriorly into the vaginal area.^[11] Changing positions normally has little effect on the discomfort, and it may even be followed by nausea and vomiting. Hematuria is a constant; however, it might be very little. Urinary frequency and urgency may be experienced if the stone is stuck at the ureterovesical junction. When the stone travels from the ureter into the bladder, all symptoms are suddenly removed. The list of possible diagnoses for flank discomfort and hematuria is short and includes renal emboli, renal tumors, urinary tract infections, and papillary necrosis with passage of a sloughed papilla.^[12]

Renal stones can contain a variety of materials, but calcium-based stones, such as calcium phosphate or calcium oxalate, are thought to be the most prevalent.^[13] When it comes to the age at diagnosis, Saudi Arabian patients typically appear between the ages of 22 and 44 years. Kidney stones are recurring once they occur, despite their rising incidence and underreported prevalence. Within the next 5 years, there is a 50% probability that it may happen again.^[14]

The principal aim of this systematic review is to do a comprehensive study of the management of adult nephrolithiasis in the Middle East, with a particular emphasis on the advancements and patterns seen during the previous 10 years. Understanding the present status of nephrolithiasis therapy is essential for improving patient outcomes and influencing health-care policy in an ever-changing health-care environment. To describe epidemiological changes, pinpoint common risk factors

specific to the Middle Eastern population, and evaluate the efficacy of various treatment approaches used in the area, this study will compile the body of available research. To give useful implications for clinical practice, public health policy, and future research initiatives in the field of nephrolithiasis care in the Middle East, we want to present a thorough overview of the existing environment through this systematic review.

MATERIALS AND METHODS

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards were followed in the conduct of this systematic review and meta-analysis.^[15] An initial search of the literature was conducted in PubMed Central to verify that there were no comparable published meta-analyses. Up to October 2023, a thorough and methodical search was conducted separately in the electronic databases of MEDLINE, CENTRAL (Cochrane Central Register of Controlled Trials), Scopus, and Google Scholar. Without regard to language limitations, searches were conducted through October 2023 of the Clinical Trials Registry (clinicaltrials.gov) and the main conference proceedings. A new search was conducted before the final analysis. The phrases “NEPHROLITHIASIS, KIDNEY STONE OR RENAL FAILURE,” and “MIDDLE EAST, SAUDI ARABIA, PREVALENCE” were used in the search. In addition, hand searches were done using the relevant references that were included in the research.

Eligibility criteria

The inclusion criteria for the systematic review were meticulously crafted to guarantee a targeted inquiry into the treatment of nephrolithiasis among Middle Eastern adults between 2013 and 2022. The following criteria were considered as inclusion criteria for this study: (1) research conducted in the Middle East, including all countries within the designated geographical region; (2) studies using a variety of methodologies, such as original research, systematic reviews, meta analyses, randomized controlled trials, cohort studies, case–control studies, and observational studies; (3) articles that specifically address the management, treatment, or prevention of nephrolithiasis in adults aged 18 and above; (4) English language articles or those with an accessible English translation; (5) papers subject to peer review; and (6) publications released between January 1, 2013, and October 31, 2023. Notably, research that only focused on juvenile nephrolithiasis, that were carried out outside of the Middle East, or that were published before 2013 would be disregarded to preserve a particular emphasis on the adult population and the Middle

East. By methodically gathering and evaluating pertinent research, these criteria seek to give a thorough picture of how nephrolithiasis has been managed in the Middle East's adult population throughout the past 10 years.

Data collection and analysis

Study selection

A methodical exploration of digital repositories including PubMed, MEDLINE, and Embase was carried out to find pertinent publications released between January 1, 2013, and December 31, 2022. The Middle East, adult populations, and nephrolithiasis-related keywords will be combined with Medical Subject Headings phrases in the search strategy. Expert medical librarians will provide feedback on the search strategy to guarantee a thorough retrieval of relevant studies.

Quality assessment

After the first search, a two-step screening procedure was put in place. Examining abstracts and titles to find papers that fit the preset inclusion requirements was the first step. The full-text publications of possibly suitable research will be evaluated for ultimate inclusion in the second phase. The screening was done by two impartial reviewers, and any differences were settled by consensus or discussion with a third reviewer.

Data extraction

A standardized form was used for data extraction to collect pertinent data, such as research design, participant demographics, intervention specifics, outcomes, and important results. Using well-known instruments, such as the Newcastle–Ottawa Scale for observational studies and the Cochrane Risk of Bias tool for randomized controlled trials, methodological quality and risk of bias assessments were carried out.

A narrative overview of the included papers was used to synthesize the data, highlighting patterns, trends, and variances in nephrolithiasis management throughout the Middle East. When possible, meta-analyses were carried out to statistically combine data from research projects with comparable designs and conclusions. Geographical location, intervention kinds, and other pertinent criteria were taken into consideration while doing subgroup analyses.

Risk of bias assessment

To improve openness and reporting quality, the review complied with the PRISMA standards. The findings of this systematic review will provide important new understandings of how nephrolithiasis is being managed in the Middle East's adult population. These insights will

impact clinical practice, direct future research projects, and maybe even have an impact on regional health care policy. This study will provide more relevant data and support future clinical research.

Statistical analysis

Strong techniques will be used in the statistical analysis for the systematic review on the treatment of nephrolithiasis in the Middle Eastern adult population to guarantee a thorough synthesis of the included research. When applicable, quantitative data taken from studies that meet the eligibility requirements will be put through a meta-analysis to get the pooled effect estimate and evaluate the overall efficacy of various management approaches. First, a comprehensive evaluation of the heterogeneity across the included studies was carried out with the use of statistical tools such as the I^2 statistic. The following provides a general framework for interpreting I^2 in the context of meta-analyses of randomized trials: 0%–30% may not be noteworthy, 30%–60% might indicate moderate heterogeneity, 40%–90% could indicate substantial heterogeneity, and 85%–100% could indicate significant heterogeneity.^[16]

RESULTS

The literature search yielded a total of 164 studies. The PRISMA flow diagram demonstrates our search and selection process [Figure 1]. After removing the duplicate studies, 80 records were screened for title and abstract. A total of 13 articles were retrieved for full-text screening, following which only six randomized studies were included for the evaluation.

Study characteristics – the characteristics of the included study are summarized in Table 1.

- Good quality: 3 or 4 stars in selection domain AND 1 or 2 stars in comparability domain AND 2 or 3 stars in exposure domain. Table 2
- Fair quality: 2 stars in selection domain AND 1 or 2 stars in comparability domain AND 2 or 3 stars in exposure domain. Table 2
- Poor quality: 0 or 1 star in selection domain OR 0 stars in comparability domain OR 0 or 1 stars in exposure domain. Table 2

DISCUSSION

Urolithiasis is a prevalent condition that is becoming more commonplace globally.^[22] The onset of urolithiasis is caused by a number of variables, including weather, food habits, water hardness, genetics, age, gender, employment, and

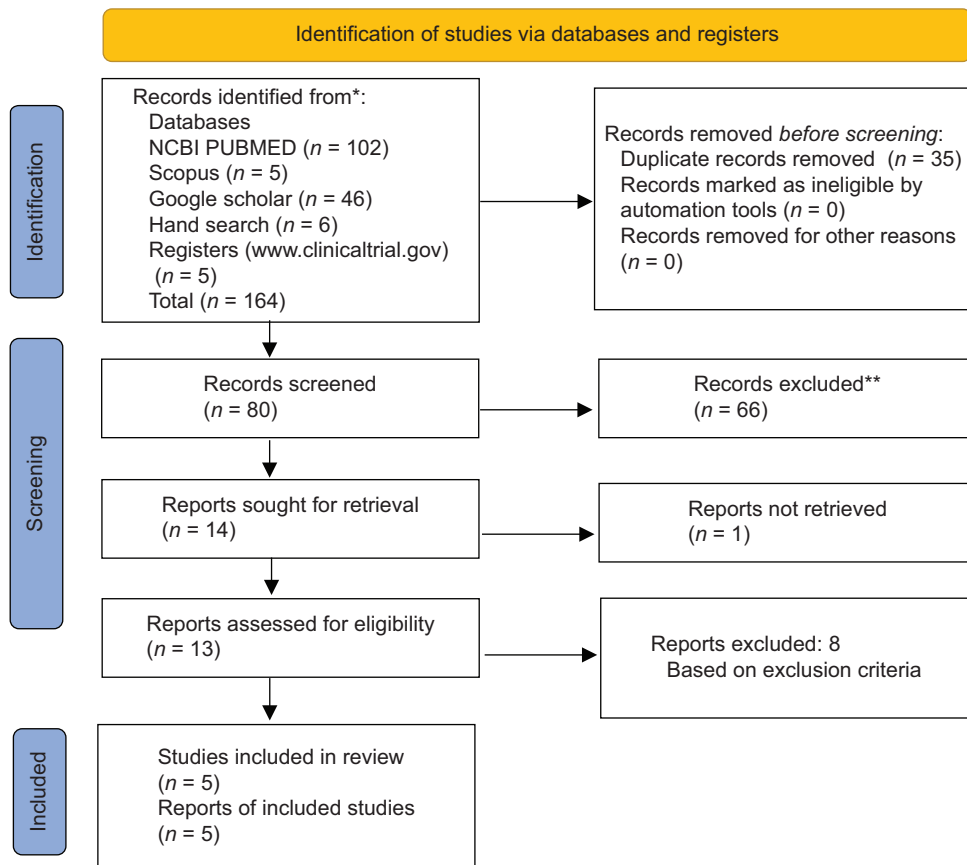


Figure 1: PRISMA Diagram reporting the number of records identified from each database or register searched. *Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers). **If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools

Table 1: Baseline characteristics

Study	Setting	Study period	Events (history of kidney stone)	Management
Moftakhar <i>et al.</i> ^[17]	Southern Iran	2014–2022	2251	Identifying individuals at risk of kidney stone and providing the necessary training can greatly help to reduce this disease
Safdar <i>et al.</i> ^[18]	Saudi Arabia	2020–2021	23	Assessing the epidemiology of renal stone to prevent its reoccurrence
Alyami <i>et al.</i> ^[19]	Saudi Arabia	2018–2021	131	Control BMI to prevent kidney stones due to obesity
Alghafees <i>et al.</i> ^[20]	Saudi Arabia	2020–2022	19	The random forest machine learning model exhibits the highest efficacy and accuracy in predicting stone-free status
Ali <i>et al.</i> ^[21]	Saudi Arabia	2021–2023	8	Reduction in energy drinks and high-fat products

BMI: Body mass index

Table 2: Summary of case-control study quality assessment using Newcastle–Ottawa Scale

Study	Selection		Comparability	Exposure/outcome		Total score
	Case definition	Case-control		Management	Nonresponse rate	
Moftakhar <i>et al.</i> ^[17]	★	★	★	★	★	5
Safdar <i>et al.</i> ^[18]	★		★	★		3
Alyami <i>et al.</i> ^[19]	★	★	★★	★	★	6
Alghafees <i>et al.</i> ^[20]	★	★	★	★	★	5
Ali <i>et al.</i> ^[21]	★		★	★	★	4

Stars indicate the rating according to the Newcastle–Ottawa Scale. Good quality: 3 or 4 stars in selection domain AND 1 or 2 stars in the comparability domain AND 2 or 3 stars in the exposure domain. Fair quality: 2 stars in the selection domain AND 1 or 2 stars in the comparability domain AND 2 or 3 stars in the exposure domain. Poor quality: 0 or 1 star in the selection domain OR 0 stars in the comparability domain OR 0 or 1 star in the exposure domain

body weight.^[2,23,24] In addition to the detrimental effects of urolithiasis on health, there are significant financial implications associated with treating afflicted persons and

missing work due to illness. The metabolic assessment and therapy of urolithiasis need the determination of the chemical makeup of stones.

Previous research has looked at a number of kidney stone-related topics in the country's Western and Central regions. Al-Hadramy observed that there were higher cases of renal colic during the sweltering summer months while examining the seasonal fluctuation of renal colic in the Western area of Saudi Arabia as reported to the emergency department.^[25] In the middle area of Saudi Arabia, Khan *et al.* examined the epidemiological risk factors and composition of urinary stones. The study conducted by the authors revealed a 5:1 male-to-female predominance and a strong correlation with the warmer months.^[26] As per our findings, the most prevalent kind of stones was discovered to be calcium oxalate, which was followed by phosphate and uric acid stones.

In the summer, temperatures in the Eastern region of Saudi Arabia can reach as high as 50°C. Urinary stone passage has increased, as seen by our observations during the hot weather. Numerous researchers in other fields have already discovered similar findings.^[3,4,11,27] The rationale is that increased urinary supersaturation, crystallization, and stone formation are caused by dehydration and the concentrated urine that results from it.^[2,28]

There has been a concerning rise in the incidence of obesity in Saudi Arabia across the board as a result of the population's changing lifestyle.^[29] The prevalence of weight anomaly has increased to the point that, in some regions of the nation, two-thirds of the population is overweight or obese.^[30] In addition to the numerous negative health effects of obesity, an increase in the incidence of kidney stones is anticipated.

The metabolic syndrome has also been linked to an increased incidence of kidney stones from uric acid and calcium oxalate, in addition to obesity.^[31-33] It has been discovered that high urine acid excretion, which lowers urine pH, is a characteristic of metabolic syndrome and is linked to the level of insulin resistance.^[34] Apart from the weight irregularities noted in our group, a significant segment of the patients had one or more metabolic abnormalities such as diabetes, hypertension, dyslipidemia, or hyperuricemia.

In a study,^[35] 70.2% of the participants said that they do PCNL, averaging 0–5 instances per month, or 10%–20% of regular practice for the majority. 59.1% of residents learned PCNL throughout their residency. However, the number of fellowship programs is rising, and a significant number of individuals (19.7%) obtain their PCNL skills through specialized local and international endourological fellowship programs.

Most patients (80.3%) had the PCNL tract acquired by urologists; compared to national statistics, Saudi Arabia has a larger percentage of urologists performing PCNL punctures than either the United States or the United Kingdom (17% and 33.7%, respectively).^[36] Research indicated that getting access through urologists might lower the likelihood of complications, which would motivate urologists to do their own accesses.^[37]

The way that renal calculus is managed has changed due to global technological advancements. Studies have shown that although the rate of ESWL is declining, the rate of RIRS is increasing due to advancements in laser devices and visibility.^[38] However, even with this rising rate of RIRS, the rate of PCNL is still increasing.^[39] This is not the case everywhere, though data from the UK showed that the rate of RIRS was increasing while the rate of PCNL remained unchanged or decreased.^[40] Curiously, when we asked participants in our survey how much they thought the introduction of flexible ureteroscopy decreased their rate of performing PCNL, 45.5% of them said that there was a 20% decrease in the rate of PCNL following the introduction of flexible ureteroscopy. However, just 15.2% of respondents said that their rate of PCNL procedures was unaffected by the introduction of flexible ureteroscopy.

Importantly, it was shown that a major contributing factor to the formation of urinary stones is metabolic syndrome, a condition that is prevalent among Saudis.^[40-42] This condition has an impact on finances and way of life. It is possible to target factors that might reduce the occurrence of this condition by assessing the community's knowledge and attitudes about it, as well as how to avoid and manage it. Urinary stone incidence and composition are influenced differently by various diets and surroundings.^[3,43,44] Urinary stone disease is predicted to be common in Saudi Arabia due to the country's high temperatures and insufficient water intake.⁽⁵¹⁾ In fact, a research conducted in the Western part of Saudi Arabia indicates that during the sweltering months of June, July, and August, more people visit the emergency room (ER) complaining of stone colic discomfort.^[45] Urinary stone cases in Saudi Arabia may be related to the previously noted relationship between metabolic syndrome and body weight. This is especially important in Saudi Arabia, where a research found an alarming 28.3% incidence of metabolic syndrome.^[2] This increased incidence in this group may be due to increased excretion of urine acid.^[46,47] According to a research, urinary stones occur at an incidence rate of 111/100000 in Eastern Saudi Arabia, where most patients have metabolic abnormalities.^[48] It is interesting to note that 50% of survey participants linked obesity to the formation of kidney

stones, which may be a sign of growing knowledge of the health risks linked to obesity. Few articles explored the knowledge and attitudes of nonhealth-care persons regarding urinary stones, despite the abundance of material on physicians' attitudes toward treating patients suspected of having them.^[49-52] The study's participants had favorable opinions toward the prevention of renal stones, with 91.4% of them concurring that consuming more fluids can stop renal stones from forming. However, most were primarily ignorant of the other dietary determinants and thought that the controversial home remedy of boiling parsley would both prevent and treat urinary stones. According to a Saudi Arabian research, urologists' understanding of preventative measures for stone recurrence is lacking. The recommended practices for preventing stones are not well implemented in their day-to-day work. It is very justified to make efforts to broaden knowledge and ensure that it is applied in day-to-day activities.^[53] The prevalence of urinary stones in this area is demonstrated by the fact that 9.6% of research participants had the ailment themselves, and 44% of participants had family members who had experienced it. This study's scope is restricted by the absence of a thorough investigation of prior medical disorders and a thorough investigation of fluid consumption, despite its attempt to examine certain elements of knowledge and attitude toward urinary stones. It is worthwhile to do a thorough investigation into the ways in which the community adopts practices that help avoid kidney stones. It is advised that these issues be included in a bigger research. Furthermore, this study's demonstration of knowledge gaps in a number of areas highlights the necessity of public health initiatives aimed at raising public awareness of this issue and its connections to metabolic syndrome in particular.

CONCLUSION

To sum up, this systematic review has given an in-depth analysis of nephrolithiasis therapy in Saudi Arabia, providing insightful information on the various approaches used in this particular health-care environment. The amalgamation of data has shed light on the diverse character of interventions, which include medical, surgical, and lifestyle methods. These approaches are indicative of the intricate interaction between environmental, cultural, and demographic elements within the Saudi Arabian populace. The conversation emphasized the need for customized therapies by highlighting the significance of dietary practices, genetic predispositions, and sociocultural factors on the occurrence and management of nephrolithiasis. The recognition of differences in health-care-seeking behavior and disparities in health-care access opened up new possibilities for focused public health programs. The

results of this systematic review not only advance our understanding of stone management globally but also lay the groundwork for future studies and the improvement of clinical guidelines to better meet the unique requirements of this population as we navigate the complex challenges presented by nephrolithiasis in Saudi Arabia. In the end, this study acts as a call to action for ongoing initiatives to optimize nephrolithiasis management in Saudi Arabia, stressing the significance of context-specific strategies in improving patient outcomes and health-care delivery.

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Conflicts of interest

There are no conflicts of interest.

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