J Ped Nephrol
Journal of Pediatric Nephrology
Winter 2023. Volume 11. Number 1

Original Article

Kidney Calculi in Iranian Children: A Multicentric Report

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Citation Akhavan Sepahi M, Sharif AS, Hooman N, Azarfar A, Mohammadjafari H, Ghasemi6 KH, et al. Kidney Calculi in Iranian Children: A Multicentric Report. Journal of Pediatric Nephrology. 2023; 11(1):31-36. https://doi.org/10.22037/jpn.v11i1.42719

https://doi.org/10.22037/jpn.v11i1.42719

Article info:
Received: July 2022
Accepted: December 2022
Publish: 01 Jan 2023

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ABSTRACT

Background and Aim: Studies on the prevalence of kidney stones in Iranian children are limited. Children with nephrolithiasis have a high risk of recurrent stones; therefore, a thorough evaluation is warranted. Due to the paucity of data on Iranian children, this study aims to investigate the prevalence of kidney stones in this population.

Methods: This cross-sectional study examined the prevalence of kidney stones among outpatients and inpatients at various university centers in Iran from March to December 2019. Twenty-six pediatric nephrologists from 13 centers participated and completed a questionnaire on the total number of inpatients and outpatients and the number of patients with kidney stones. The diagnosis was based on radiological results.

Results: A total of 97 912 patients were included, with 20327 hospitalized and 77585 outpatients. Of all patients, 2.86% had kidney stones, the prevalence of which was 1.5% in inpatients and 3.2% in outpatients. This figure is about 1% more than Iran's past reports. Inpatient stones in Kerman City, Iran (3.65%) and outpatients in Zahedan City, Iran (16.4%)

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were the most common. The study lacked data on age and gender. The main results are the total and setting-specific prevalences, and regional variations suggesting environmental and genetic factors.

Conclusion: This large study examined kidney stone prevalence in Iranian children, the total prevalence of which is 2.86%. Given the limited data and rising trend, more extensive studies with the collaboration of additional centers are recommended. Demographic characteristics, such as age, sex, stone composition, family history, and diet should be examined.

Keywords: Pediatrics, Urolithiasis, Prevalence, Multicenter studies

Introduction

alyceal microlithiasis is an ultrasound finding characterized by particles less than 3 mm in diameter, representing the first stage of stone formation [1-4]. Nephrolithiasis in children is increasingly recognized as a major source of morbidity and cost in the United States (U.S.). In the U.S., kidney stones cause 1 in 1000-7500 pediatric hospitalizations [5]. Recent estimates show pediatric nephrolithiasis costs $229 million annually for hospital admissions and $146 million for emergency care [6]. Pediatric patients tend to form stones recurrently, with a recurrence rate of 6.5%-44% [7]. This tendency, along with the destructive nature of stone formation, can lead to a gradual decline in kidney function [8, 9].

The global prevalence of kidney stones is 1%-15% [10], and in Iran, it is around 2%-3% [11], having increased by 6%-10% annually during the last two decades [12, 13]. An Iranian cross-sectional study on 110 primary school children (56 girls, 54 boys) aged 7-11 years showed that only one child (1%) had kidney stones. The most prevalent urine metabolic abnormalities were hypercalciuria (23%) and hypocitraturia (100%) [14]. The prevalence varies geographically and is higher in developed countries than in developing countries [15-18]. Reasons may include improved imaging techniques and economic growth that increases protein consumption [19, 20].

Given the uncertain prevalence and importance of pediatric kidney stones in terms of complications, morbidity, and costs, strategies are needed to optimize evaluation and treatment, reducing recurrence risk through medical and dietary management. This study was conducted to investigate the prevalence of Iranian children. If it is high, screening and identification of risk factors should be pursued to enable early correction and prevent complications.

Materials and Methods

This descriptive, cross-sectional study was conducted to investigate the prevalence of kidney stones among outpatients and inpatients at different university centers in Iran between March and December 2019. Pediatric nephrologists were invited to participate. Of 120 invitees from 31 centers, 50 people agreed to participate and 26 people from 13 centers completed a questionnaire on the total number of outpatients and inpatients, and the number of people with kidney stones. The diagnosis was based on radiological findings from ultrasound and computerized tomography (CT) scans. To analyze the results, descriptive statistics (frequency, percentage) were calculated using SPSS software, version 20.

Results

This study examined the prevalence of kidney stones among 20 327 inpatients and 77 585 outpatients at different university centers in Iran in 2019. Of inpatients, 324 (1.5%) had nephrolithiasis. Among outpatients, 2483 (3.2%) had kidney stones, with an overall prevalence of 2.86%. Most inpatient cases were in Kerman City, while most outpatient cases were in Zahedan City. The high prevalence in southeastern Iran indicates that regional genetic, metabolic, and environmental factors, including water and diet, should be evaluated (Table 1).

Discussion

The prevalence of kidney stones varies worldwide. Studies in Western countries have reported a higher prevalence versus Asia, with rates of 1%-5% in Asia, 5%-9% in Europe, 12% in Canada, and 13%-15% in the United States [21, 22]. In the Mediterranean and Middle East region, the prevalence in Turkey has been reported as 2.1%-5.8% [23], Saudi Arabia up to 20% [21, 22], and Egypt 2.8%-5.7% [24].

Table 1. Prevalence of kidney calculi in Iranian children

Center	City	Number of Nephrologist	Number of Patients			
			Inpatient		Outpatient	
			No.	No. (%)	No.	No. (%)
			Total	Calculi	Total	Calculi
1	Bandarabbas	2	NA	NA	10170	431(4.23)
2	Bushehr	1	NA	NA	3460	38(1.09)
3	Mazandaran	3	903	32(3.54)	10747	265(2.46)
4	Tehran	6	11372	162(1.42)	17163	373(2.17)
5	Qom	2	NA	NA	2400	165(6.87)
6	Shiraz	2	3964	4(0.1)	860	31(3.6)
7	Ghazvin	1	3540	47(1.32)	9540	180(1.88)
8	Sanandaj	2	NA	NA	5300	450(8.49)
9	Semnan	1	NA	NA	2900	195(6.72)
10	Mashhad	3	360	26(7.22)	7756	216(2.78)
11	Zahedan	1	NA	NA	579	95(16.4)
12	Kerman	1	115	42(36.52)	NA	NA
13	Shahrekord	1	73	11(15)	6800	44(0.6)
Total			20327	324(1.59)	77585	2483(3.2)

NA: Not available.

Our study found an overall prevalence of 2.86% among Iranian children, with 1.5% in inpatients and 3.2% in outpatients. This is significantly higher than past Iranian studies reporting around 1%, and more similar to rates in Western nations. Considerable regional variations were also found where stones were most common in Kerman City for inpatients and Zahedan City for outpatients. The lack of age, gender, and other demographic data limited the analysis of potential risk factors.

A study conducted by Azarfar et al. reviewed articles on kidney stones and microlithiasis in children from PubMed, Scopus, Web of Science, and other databases. Of 84 articles, 9 articles examined prevalence. Two people found hypercalciuria in 10%-80%, hyperuricosuria in 5%-21%, hypocitraturia in 10%-96%, hyperoxaluria in 5%-26%, and cystinuria in 1%-4%. Family history and urinary infections were reported in 27%-67% and 1.1%-38%, respectively.

Pourbakhtiaran [23] conducted a prevalence study in the age group of 7-11 years. Of 932 students, 78% had normal ultrasounds and 22% had abnormalities, including hydronephrosis (1.1%), fullness of the urinary tract (0.1%), urinary system duplication (3%), stones (0.7%), decreased kidney size (0.4%), thickened bladder (8.9%), and other findings (7.8%). Another study on 199 children aged 27.7±27.9 months showed that 16.1% had urinary reflux and 1% had kidney stones [24].

A study conducted by Mohammad Jafari et al. on 271 children aged 2 months to 16 years showed that 91 children (33.6%) had a positive family history, abdominal pain (18.8%), urinary tract infection (UTI) (11.8%), and hematuria (11.4%). A total of 35.1% had metabolic, 10% infectious, and 4.1% obstructive causes, while 110 had no definable etiology. Hypercalciuria (25.5%), hyperoxaluria (18.4%), and hypocitraturia (18.1%) were more common than uricosuria (8.5%) and cystinuria (3.1%) [25].

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A review of 1050 studies by Moudi et al. showed that pediatric nephrolithiasis is increasing globally, especially in girls. Proposed reasons include lifestyle, diet, obesity, metabolic syndrome, and imaging referral patterns [26]. However, metabolic factors and urinary tract infection (UTI) are still the main risks [27]. Metabolic causes include hypercalciuria, hyperuricosuria, hyperoxaluria, renal tubular acidosis, and infection [28]. Patients with multiple, recurrent, and positive family history of stones have indications for metabolic evaluation. To assess the metabolic rate of nephrolithiasis, 2 or 3 separate 24-hour urine samples should be taken for calcium, oxalic acid, phosphate, uric acid, cysteine, and creatinine [29, 30]. Hypercalciuria is defined as increased urinary calcium excretion >4 mg/kg/day [31]. Hypercalciuria and hypocitraturia are the most common and often cause calcium oxalate or calcium phosphate stones [5, 32]. Moreover, some drugs, such as ceftriaxone are associated with nephrolithiasis [33].

Urinary tract abnormalities, such as ureteropelvic junction (UPJ) obstruction, calyceal diverticula, horseshoe kidney, ureteroceles, bladder exstrophy, and posterior valves are associated with stones [34]. Urease-producing organisms, such as Proteus and Klebsiella raise urine pH, causing calcium phosphate and struvite stones [30, 35]. Along with treating underlying metabolic factors and obstructions, identifying stone composition aids management [36].

More extensive collaborative studies are needed to confirm the prevalence and elucidate the demographic and etiological factors underlying pediatric nephrolithiasis across different regions of Iran. This issue facilitates early detection and prevention efforts, which are critical given the risks of recurrent stones and kidney damage in children.

Conclusion

This cross-sectional study showed that the overall prevalence of kidney stones among Iranian children is 2.86%, and its prevalence is higher in outpatients (3.2%) compared to inpatients (1.5%). The total prevalence was significantly higher than previous Iranian studies reporting around 1%. Considerable regional variations were also found where stones were more common in Kerman City for inpatients and Zahedan City for outpatients.

These results suggested that kidney stones are becoming more prevalent in the pediatric population nationally. In addition, the regional differences indicated that environmental and genetic factors may contribute to stone risk and warrant further investigation. The lack of age, gender, and other demographic data limited the analysis of potential risk factors.

More extensive collaborative studies are recommended to confirm the prevalence and elucidate the demographic and etiological factors underlying pediatric nephrolithiasis in Iran. This will help guide early detection and prevention efforts, which are critical given the risks of recurrent stones and kidney damage in children.

Strengths and limitations

Many centers did not have electronic information to record the results and therefore, they could not participate, and we should have a multicenter study to record more accurate information Also, the reported information was only about the number of patients and we do not have information about the distribution of age, sex, family history, and the stone composition.

Ethical Considerations

Compliance with ethical guidelines

There were no ethical considerations to be considered in this research.

Funding

This research did not receive any grant from funding agencies in the public, commercial, or non-profit sectors.

Authors' contributions

Conceptualization: Mohsen Akhavan Sepahi, Amin Sadat Sharif, Nakysa Hooman and Anoush Azarfar; Methodology: Hamid Mohammadjafari, Khadijeh Ghasemi and Maryam Esteghamati; Investigation: Zahra Pournasiri, Reza Dalirani, Nasrin Esfandiar, Ali Derakhshan; Original draft preparation: Hadi Sorkhi, Elham Emami, Farzaneh Ghazanfaripour, Banafsheh Arad, Simin Sadeghi –bojd, Rama Naghshizadian, Banafshe Dormanesh, Kambiz Ghasemi, Mojgan Mazaheri and Sahar Sadr; Review and editing: Fatemeh Ghane Sharbaf, Mohammad Reza Razavi, Fatemeh Emamghorashi, Masoumeh Mohkam, Alireza Eskandarifar and Mahmood Maleknejad.

Conflict of interest

The authors declared no conflict of interest.

Acknowledgments

The authors thank Ali Asghar Clinical Research Development Center (AACRDC) for editorial, statistical and search assistance throughout study.

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