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Urinary stone disease in pediatric patients: a mixed-methods study

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ABSTRACT

Aims: Childhood urinary stone disease (USSD) varies in frequency based on several factors such as, gender, age, body mass index, geography, diet, genetic disorders, and kidney anatomy. This study aims to retrospectively evaluate the demographic and clinical characteristics, symptoms, diagnostic methods, predisposing factors, associated urinary system anomalies, treatments, and prognosis of patients diagnosed with USSD in our clinic over the past three years.

Methods: This mixed-methods study retrospectively examined the records of 175 patients diagnosed with USSD between April 2020 and May 2023. Demographic data, symptoms, laboratory results, imaging findings, and treatment outcomes were analyzed. Additionally, qualitative data were gathered from semi-structured interviews with 10 volunteer participants to understand the impact of symptoms on their lives.

Results: Among the 175 pediatric patients diagnosed with urolithiasis, 120 (68.5%) were symptomatic, with common complaints such as irritability (29.1%), pain (18.2%), vomiting (23.4%), and macroscopic hematuria (20%). Significant differences were observed in symptoms based on age and stone size, with older children more likely to experience pain and hematuria, while younger children showed more irritability ($p<0.01$). Metabolic disorders were present in 78.8% of cases, with hypercalciuria being the most frequent. Qualitative data revealed significant emotional and social challenges. Children expressed fear, anxiety, and embarrassment due to symptoms like pain and bedwetting. These experiences impacted their daily lives, disrupting sleep, play, and social interactions. Family support played a crucial role in managing these emotional burdens, though peer interactions often exacerbated feelings of isolation and discomfort.

Conclusion: The study highlights the critical importance of early diagnosis and individualized treatment strategies in managing pediatric urolithiasis to prevent long-term complications like end-stage renal failure. Presenting symptoms and treatment outcomes are significantly influenced by factors such as age, stone size, and metabolic risk factors. Medical treatment remains the primary approach, while surgical interventions are reserved for complex cases. The findings emphasize the need for personalized management plans, particularly for high-risk children with family history or consanguineous marriages, and underscore the emotional and social challenges these children face.

Keywords: Childhood urinary stone disease, USSD, demographics and clinical characteristics, symptoms, metabolic risk factors

INTRODUCTION

The prevalence of urinary system stone disease (USSD) varies in studies depending on several factors such as race, gender, age, body mass index, geography, diet, genetic diseases, and the anatomical structure of the kidney.[1,2] The earliest historical records of this disease date back to 4400 BC. A significant increase in the frequency of the disease has been observed from the Industrial Revolution to the present day.[3]

Metabolic risk factors play a crucial role in the development of kidney stone disease and its recurrence. These factors include metabolic disorders such as hypercalciuria, hyperoxaluria, hypocitraturia, and hyperuricosuria. Hypercalciuria, characterized by excessive calcium excretion in the urine, is one of the most common metabolic causes of kidney stones, particularly leading to the formation of calcium oxalate stones.[4] Metabolic syndrome has also been identified as an important contributor to kidney stone formation, with conditions like hypercalciuria further reinforcing this link. Additionally, hypercalciuria has been shown to significantly increase the risk of stone recurrence, particularly in pediatric patients.[5] Hyperoxaluria, which involves the excessive excretion of oxalate in the urine, is another major metabolic disorder contributing to kidney stone development, known for increasing both the hardness of the stones and the likelihood of recurrence.[6]

Hypocitraturia, a deficiency of citrate-a natural inhibitor of stone formation-facilitates the development of calcium stones

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and has been observed more frequently in obese children, raising their risk of stone formation.[7] Hyperuricosuria, characterized by excessive uric acid excretion, leads to the formation of uric acid stones and requires special consideration in treatment and follow-up.[8] These metabolic disorders not only accelerate stone formation but also complicate the treatment process and increase the risk of recurrence. Therefore, early diagnosis and effective management of these metabolic risk factors are essential for improving the prognosis of individuals prone to kidney stone disease.[4-8]

In studies conducted in the United States, Soucie and colleagues determined the lifetime prevalence of urinary system stones to be 4% in women and 10% in men, while Curhan and colleagues found this rate to be 8.7% regardless of gender.[9,10] In childhood, most stones consist of calcium oxalate (45-65%) and calcium phosphate (14-30%), whereas uric acid, cystine, and struvite (magnesium-ammonium-phosphate) stones are seen at lower rates (5-10%).[11] Symptoms can vary with age. In a young child, symptoms like irritability, non-specific abdominal pain, and nausea can present, while in older children or adolescents, these symptoms are replaced by classic symptoms specific to stone disease such as renal colic pain, flank pain, nausea, and vomiting. Hematuria can be present in 30-90% of children with stones, although significant macroscopic hematuria is rare. The diagnosis of urolithiasis in young children is often made during the follow-up of urinary tract infections (UTIs) or incidentally.[12]

The classic symptoms and findings of urolithiasis are less clear in children compared to adults, leading to delayed diagnosis, which can result in chronic pyelonephritis and end-stage renal failure. The risk of chronic renal failure is 1.7% in idiopathic calcium oxalate stones but can rise to 70% in patients with cystinuria.[13] The Turkish Society of Nephrology reported that urolithiasis accounted for 3.3% of the etiology in children who started renal replacement therapy in 2008 due to chronic renal failure.[14]

The primary aim of this study is to retrospectively evaluate the demographic characteristics, clinical findings, diagnostic and treatment processes, metabolic factors contributing to stone formation, and prognoses of pediatric patients diagnosed with urolithiasis who have been followed up in our clinic over the past three years. In the study, the retrospective data of 175 patients were analyzed, and qualitative data were also collected from 10 patients to gain in-depth insights into their experiences with the disease. The study focuses on identifying the factors contributing to stone formation in pediatric urolithiasis cases and assessing the risk of stone recurrence. The quantitative aspect of the study involves analyzing patient data such as age, gender, family history, and laboratory and imaging results to gather critical information about the clinical course of the disease. On the other hand, the qualitative aspect aims to evaluate the individual experiences of patients and their families, focusing on how urolithiasis impacts the quality of life in children. The combination of both methods offers a comprehensive view of the disease's clinical, biological, social, and psychological effects.

In line with the research objective, the study seeks to answer the following sub-questions:

- What are the demographic characteristics and clinical findings of urolithiasis patients at the time of presentation?
- What metabolic risk factors are identified in urolithiasis patients, and how do these factors affect stone formation and recurrence risk?
- What laboratory and imaging methods are used in the diagnosis of urolithiasis, and how effective are these methods?
- What are the prognoses of urolithiasis patients, and what are the recurrence rates of the stones?
- How does urolithiasis affect the lives of children diagnosed with the disease, and how do the children and their families experience the disease process?

The significance of this study stems from the fact that pediatric urolithiasis has typically been studied in the context of adult populations in the literature. Children with kidney stones often present with fewer or different symptoms compared to adults, complicating the diagnostic and treatment processes. Moreover, the impact of metabolic risk factors in pediatric patients has not been thoroughly investigated, and this study aims to fill that gap by providing important contributions to this area. Additionally, the qualitative exploration of patients' personal experiences allows for a better understanding of the social and psychological aspects of the disease. Thus, a holistic evaluation that encompasses both clinical and patient perspectives will reveal the multidimensional impacts of pediatric urolithiasis. This study is expected to serve as a foundation for future research and offer insights to improve the management of the disease in clinical practice.

METHODS

In this study, the records of 175 patients who had been followed for at least 12 months with a diagnosis of urolithiasis at the Pediatric Nephrology Clinic of the Samsun Training and Research Hospital between April 2020 and May 2023 were retrospectively reviewed. The research was approved by the Ethics Committee of Samsun University (Date: 14.08.2024, Decision No: 2024/14/2). The ethics committee approval is included in the supplementary file. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki. Patients' age, gender, family history and presenting complaints were obtained from patient records. Urine culture, spot urine calcium/creatinine ratio, oxalate/creatinine, citrate/creatinine ratio, uric acidxGFR or 24-hour metabolic stone analyses and routine ultrasonography findings were identified from the records. The distribution of the demographic characteristics of the cases is shown in Table 1. Retrospective data collection was acknowledged as having potential limitations such as missing or inaccurate records; however, efforts were made to minimize these limitations by using well-documented and consistent clinical records.

Table 1. Distribution of demographic characteristics			
		n	%
Diagnosis age	0-1 year	100	57.1
	1-3 years old	24	13.7
	3-5 years old	12	6.8
	5-10 years old	25	14.2
	≥10 years old	14	8
Gender	Male	90	51.4
	Female	85	48.6
Family history	Yes	105	61.04
	No	70	38.9
Consanguineous marriage	Yes	25	14.2
	No	150	85.7

The study was designed as a mixed-methods research. Mixed-methods research is an approach that combines qualitative and quantitative research methods. In this method, the processes of collecting, analyzing, and interpreting qualitative and quantitative data are integrated.[15] The aim of mixed-methods research is to comprehensively and in-depth examine the research question by leveraging the strengths of both methods.[16] In this study, quantitative and qualitative data were not only collected separately but also carefully integrated to provide a more comprehensive understanding of the research findings. The integration of both data types was essential to address the complexity of urolithiasis in pediatric patients, offering both statistical trends and personal experiences.

Urolithiasis patients with urinary system infection were evaluated as those who had a history of urinary tract infection and those in whom a significant number of bacteria grew in urine culture at the time of presentation. In ultrasonographic imaging, stones 3 mm and smaller were considered microcalculi, while stones larger than 3 mm were considered macrocalculi. Urinary incontinence was evaluated in patients over the age of 3 who were out of diapers, had completed toilet training, and had gained daytime bladder control.

Calcium excretion in spot urine was defined as hypercalciuria if it was >0.8 mg/mg creatinine for 0-6 months, >0.6 mg/mg creatinine for 7-12 months, and >0.21 mg/mg creatinine for those older than 2 years. For 24-hour urine, calcium excretion over 4 mg/kg/day was also considered hypercalciuria. Oxalate excretion in spot urine was considered hyperoxaluria if it was >0.15-0.26 mmol/mmol creatinine for those under 1 year, >0.11-0.12 mmol/mmol creatinine for those aged 1-5 years, >0.006-0.15 mmol/mmol creatinine for those aged 5-12 years, and >0.002-0.083 mmol/mmol creatinine for those older than 12 years. For all age groups, oxalate excretion over 0.5 mmol/1.73 m^2/day in 24-hour urine was also considered hyperoxaluria. Uric acid excretion in spot urine was defined as hyperuricosuria if it was 3.3 mg/dL GFR in term infants and >0.53 mg/dl GFR in patients older than 3 years. In 24-hour urine, uric acid excretion over 815 mg/1.73 m^2/day was also considered hyperuricosuria. Citrate excretion was defined as hypocitraturia if it was below 400 mg/g creatinine in spot urine and below 180 mg/g in 24-hour urine.

During follow-ups, the absence of stones in at least two consecutive ultrasound examinations was considered recovery. Recurrence was defined as the detection of stones by ultrasound again or stone passage in patients who had no stones in at least two consecutive ultrasound examinations.

In the qualitative part of the study, data were collected through semi-structured interviews with 10 volunteer participants out of the 175 patients. The 10 volunteer participants were selected based on typical case sampling. Participants were chosen from those who took part in the quantitative part of the study and were considered representative of the 175-person quantitative sample according to the findings of the disease. The use of typical case sampling was justified by its ability to capture the most representative characteristics of the overall population, ensuring that the insights gained from these cases could be generalized to similar populations. Typical cases are situations that, among many similar ones in the population, provide enough information to generally explain the phenomenon or case being examined.[17] At this point, a typical case refers to situations that have the ability to represent the population and do not differ from the population in terms of fundamental characteristics.[18] The questions and answers in the semi-structured interview form were kept short due to the limited responses and age groups of the children. Although data saturation was reached with the 8th participant, the research was limited to 10 participants.

The semi-structured interview form was developed considering the literature on the disease. The questions were designed to ensure effective communication with the children. The qualitative part of the study aimed to allow patients to describe in their own words how their presenting complaints affected their lives. This approach aimed to provide a new dimension to the literature and offer insights into how patients describe their complaints.Parents accompanied the patients during the interviews. The presence of parents was carefully managed to ensure it did not influence the children's responses. Steps were taken to minimize parental interference during interviews, though their presence was necessary due to the young age of the participants.

Although data saturation was reached with the 8th participant, the decision was made to continue with 10 participants to ensure comprehensive data collection. The decision to limit the interviews to 10 participants was based on the practical considerations of the sample and the ability to gather sufficient data for analysis, balancing the need for depth against the constraints of time and participant availability. The interviews were short, planned to last between 7-10 minutes due to the young age of the children, resulting in a total of 86 minutes of data collected from participants aged 3 years and older. Although the interviews were short, every effort was made to ensure that the questions were concise yet sufficiently detailed to elicit meaningful responses from the participants.

Statistical Analysis

In line with best practices in mixed-methods research, quantitative and qualitative data were analyzed separately and then integrated in the interpretation phase to provide a comprehensive understanding of the study outcomes.

The statistical analyses of the findings obtained in this study were performed using SPSS (Statistical Package for Social Sciences) Windows 15.0 software. When evaluating the study data, descriptive statistical methods such as mean, standard deviation, and frequency values were calculated. To compare qualitative data, the Chi-Square test was applied, and Fisher's Exact test was preferred for smaller sample groups to obtain more reliable results. A significance level of $p<0.05$ was accepted for statistical analyses, indicating a 95% confidence level for the findings to be considered statistically significant. This approach ensured the robust statistical interpretation of the quantitative data, providing scientifically valid conclusions.

In the qualitative part, data were transcribed and analyzed using content analysis with the help of the NVIVO program. The aim was to allow patients to describe in their own words how their presenting complaints affected their lives, thereby offering a new dimension to the understanding of pediatric urolithiasis. In particular, care was taken to ensure that the themes identified from the qualitative data were aligned with the clinical trends observed in the quantitative data, thus strengthening the mixed-methods approach by linking patient narratives to clinical outcomes.

RESULTS

Among the presenting complaints, it was found that 120 cases (68.5%) were symptomatic, while 55 cases (31.5%) were asymptomatic. Among the symptomatic cases, the presenting complaints were as follows: 36 cases (20.5%) had nausea, 41 cases (23.4%) had vomiting, 13 cases (7.4%) had stone passage, 35 cases (20%) had macroscopic hematuria, 24 cases (13.7%) had dysuria, 19 cases (10.8%) had urinary incontinence, 51 cases (29.1%) had irritability, and 32 cases (18.2%) had pain.

According to the data in Table 2, there were significant differences in the distribution of presenting complaints by age at diagnosis. Nausea (61% vs. 19.4%, 2.7%, 11.1%, and 5.5%; p=0.168), vomiting (73.1% vs. 14.6%, 2.4%, 9.75%, and 3%; p=0.192), stone passage (30.7% vs. 23%, 0%, 15.3%, and 30.7%; p=0.404), and asymptomatic findings (65% vs. 12%, 3%, 15%, and 5%; p=0.341) did not show statistically significant differences among age groups. However, there were significant differences in some complaints depending on the age at diagnosis.

Macroscopic hematuria (60% vs. 8.5%, 2.8%, 22.8%, and 5.7%; p=0.002), dysuria (45.8% vs. 16.6%, 4.1%, 12.5%, and 20.8%; p=0.001), urinary incontinence (0% vs. 0%, 31,5%, 63%, and 5,5%; p=0.001), irritability (88.2% vs. 7.8%, 3.9%, 0%, and 0%; p=0.001), and pain (0% vs. 9.3%, 6.2%, 28.1%, and 56.2%; p=0.001) showed significant variations by age at diagnosis. The rate of macroscopic hematuria was significantly higher in children aged 5 years and older compared to those under 5 years ($p<0.01$). Dysuria was more frequent in children aged 10 years and older compared to those under 10 years ($p<0.01$). The rate of urinary incontinence was notably higher in the 5-10 year age group compared to other age groups ($p<0.01$). Incontinence complaints in the 0-1 and 1-3 age groups were not taken into consideration. Irritability was significantly more common in the 0-1 year age group compared to other age groups ($p<0.01$). Lastly, pain was significantly more prevalent in children aged 5 years and older compared to those under 5 years ($p<0.01$).

These findings demonstrate a significant relationship between the age at diagnosis and the frequency of certain presenting complaints. Specific complaints are more commonly observed in certain age groups, highlighting the importance of considering the age at diagnosis in clinical evaluations.

According to the table data, there are significant differences in the distribution of presenting complaints based on stone size. For the stone sizes, the rates of nausea (30.5% vs. 69.4%; p=0.475), vomiting (43.9% vs. 56.1%; p=0.744), stone passage (38.4% vs. 61.6%; p=1.000), and asymptomatic findings (43.6% vs. 56.3%; p=0.395) did not show statistically significant differences. However, some complaints showed significant differences depending on stone size.

Macroscopic hematuria (22.8% vs. 77.2%; p=0.079), dysuria (25% vs. 75%; p=0.076), urinary incontinence (21% vs. 79%; p=0.014), irritability (39.2% vs. 60.7%; p=0.019), and pain (25% vs. 75%; p=0.001) showed significant variations based on stone size. The occurrence of pain was significantly higher in cases with stone sizes over 3 mm ($p<0.01$), while the occurrence of irritability was significantly higher in cases with stone sizes under 3 mm ($p<0.05$).

Table 2. Evaluation of presenting complaints by age at diagnosis

	Diagnosis age					
	0-1 year	1-3 years old	3-5 years old	5-10 years old	≥10 years old	
Presenting complaints	n (%)	n (%)	n (%)	n (%)	n (%)	p
Nausea	22 (61%)	7 (19.4%)	1 (2.7%)	4 (11.1%)	2 (5.5%)	0.168
Vomiting	30 (73.1%)	6 (14.6%)	1 (2.4%)	4 (9.75%)	0 (3%)	0.192
Passage of stone	4 (30.7%)	3 (23.0%)	0 (0%)	2 (15.3%)	4 (30.7%)	0.404
Asymptomatic	45 (65%)	3 (12%)	1 (3%)	4 (15%)	2 (5%)	0.341
Macroscopic hematuria	21 (60%)	3 (8.5%)	1 (2.8%)	8 (22.8%)	2 (5.7%)	0.002**
Dysuria	11 (45.8%)	4 (16.6%)	1 (4.1%)	3 (12.5%)	5 (20.8%)	0.001**
Urinary incontinence	0 (0%)*	0 (0%)*	6 (31.5%)	12 (63%)	1 (5.5%)	0.001**
Restlessness	45 (88.2%)	4 (7.8%)	2 (3.9%)	0 (0%)	0 (0%)	0.001**
Pain	0 (0%)	3 (9.3%)	2 (6.2%)	9 (28.1%)	18 (56.2%)	0.001**

[1]Chi-square test, *Incontinence complaints in the 0-1 and 1-3 age groups were not taken into consideration, **p<0.05

These findings demonstrate a significant relationship between stone size and the frequency of certain presenting complaints. Pain complaints are more common in patients with larger stones, while irritability is more frequent in patients with smaller stones (Table 3).

Table 3. Evaluation of presenting complaints by stone size

	Stone size		
	Less than 3 mm	3 mm and above	
Presenting complaints	n (%)	n (%)	p
Nausea	11 (30.5%)	25 (69.4%)	[2]0.475
Vomiting	18 (43.9%)	23 (56.1%)	[1]0.744
Passage of stone	5 (38.4%)	8 (61.6%)	[2]1.000
Asymptomatic	24 (43.6%)	31 (56.3%)	[1]0.395
Macroscopic hematuria	8 (22.8%)	27 (77.2%)	[1]0.079
Dysuria	6 (25%)	18 (75%)	[1]0.076
Urinary incontinence	4 (21%)	15 (79%)	[1]0.014*
Restlessness	20 (39.2%)	31 (60.7%)	[1]0.019*
Pain	8 (25%)	24 (75%)	[1]0.001**

[1]Chi-square test, [2]Fisher's Exact test, *p<0.05, **p<0.01

According to the table data, there are significant differences in the distribution of presenting complaints based on whether the stone is single or multiple. The rates of nausea (63.8% vs. 36.1%; p=0.518), vomiting (53.6% vs. 46.3%; p=0.308), stone passage (46.1% vs. 53.9%; p=0.581), asymptomatic findings (60% vs. 40%; p=0.779), macroscopic hematuria (65.7% vs. 34.3%; p=1.000), dysuria (58.3% vs. 41.7%; p=0.496), urinary incontinence (78.9% vs. 21.1%; p=0.108), and irritability (52.9% vs. 47.1%; p=0.341) did not show statistically significant differences based on whether the stone is single or multiple. However, there was a significant difference in pain complaints depending on whether the stone was single or multiple (56.2% vs. 43.7%; p=0.004).

These findings indicate that the presence of single or multiple stones does not significantly affect the frequency of other presenting complaints except for pain. The pain complaint significantly varies based on whether the stone is single or multiple; pain is more common in cases where the stone is single (p<0.01). This emphasizes that the number of stones is an important factor in clinical evaluation, particularly regarding pain complaints (Table 4).

When evaluating metabolic risk factors, a total of 173 cases underwent metabolic assessment. Metabolic disorders were present in 138 patients, while no metabolic disorders were found in 35 patients. Among these cases, 50 (36.2%) had hypercalciuria, 29 (21.01%) had hyperoxaluria, 25 (18.11%) had hypocitraturia, 5 (3.6%) had hyperuricosuria, 12 (8.69 %) had both hypercalciuria and hyperoxaluria, 6 (4.34%) had both hypercalciuria and hypocitraturia, 3 (2.17%) had both hypocitraturia and hyperoxaluria, 2 (1.44%) had both hypercalciuria and hyperuricosuria, 2 (1.44%) had both hypocitraturia and hyperuricosuria, 2 (1.44%) had hypercalciuria, hypocitraturia, and hyperoxaluria, 1 (0.72%) had hypercalciuria, hypocitraturia, and hyperuricosuria,

Table 4. Distribution of presenting complaints by stone count

		Stone count		
		Single	Multiple	
Presenting complaints		n (%)	n (%)	p
Nausea	Yes	23 (63.8%)	13 (36.1%)	0.518
Vomiting	Yes	22 (53.6%)	19 (46.3%)	0.308
Passage of stone	Yes	6 (46.1%)	7 (53.9%)	0.581
Asymptomatic	Yes	33 (60%)	22 (40%)	0.779
Macroscopic hematuria	Yes	23 (65.7%)	12 (34.3%)	1.000
Dysuria	Yes	14 (58.3%)	10 (41.7%)	0.496
Urinary incontinence	Yes	15 (78.9%)	4 (21.1%)	0.108
Restlessness	Yes	27 (52.9%)	24 (47.1%)	0.341
Pain	Yes	18 (56.2%)	14 (43.7%)	0.004**

Chi-square test, **p<0.01

and 1 (0.72%) had hypocitraturia, hyperuricosuria, and hyperoxaluria. Hypercalciuria was the most common metabolic disorder observed. The most frequently co-occurring metabolic disorders were hypercalciuria and hyperoxaluria. Cystinuria was not detected in any cases. There were no statistically significant differences in the occurrence rates of hypercalciuria, hypocitraturia, and hyperuricosuria according to the age at diagnosis (p>0.05). Cystine was measured in the urine of 35 patients, and cystinuria was not detected in any of them. The prevalence of metabolic disorders by age at diagnosis is summarized in Figure.

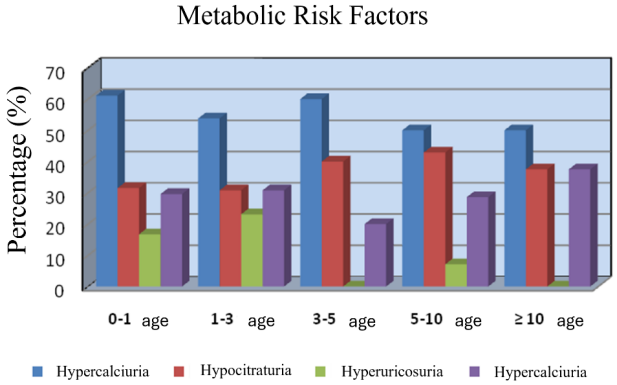

Figure. Metabolic assessment by age at diagnosis

When examining the distribution of treatment and prognosis, 156 cases (89.1%) received medical treatment, 14 cases (8%) underwent surgical treatment, and 5 of these (2.8%) were treated with ESWL (Table 5). Outcome information was available for 173 patients. Among these, 150 cases (85.7%) achieved complete recovery, 18 cases (10.2%) did not achieve complete recovery, and 5 cases (2.8%) experienced stone recurrence. There were no statistically significant differences in age at diagnosis, gender, stone size, incidence of urinary infections, and presence of metabolic disorders based on prognosis (p>0.05) (Table 6).

In the research, qualitative data obtained were analyzed with codes and anecdotes under the theme 'Chief Complaints of Kidney Stones'. Codes and anecdotes related to the chief complaints of 10 participants are presented in Table 7.

Table 5. Distribution of treatment and prognosis			
		n	%
Treatment	Medical	156	89.1
	Surgical	14	8
	ESWL	5	2.8
Prognosis	Total	175	85.7
	Complete recovery	150	
	No complete recovery	18	10.2
	Stone recurrence	5	2.8
	Total	173	

The qualitative data obtained from the study provides codes that support the presenting complaints, showing complete alignment between the obtained codes and the chief complaints. Additionally, the anecdotes provided reveal the problems patients experience during the course of kidney stone disease. The data highlights that anecdotes depict a challenging process for children in the relevant age groups.

The data from the qualitative analysis, especially from the codes and anecdotes, paints a vivid picture of the daily struggles experienced by children suffering from kidney

Table 6. Evaluations according to prognosis					
		Prognosis			
		Complete recovery	No complete recovery	Stone recurrence	
		n (%)	n (%)	n (%)	p
Diagnosis age	0-1 year	85 (85%)	12 (12%)	3 (%3)	0.251
	1-3 years old	22 (91.6%)	2 (8.4%)	0 (%0)	
	3-5 years old	11 (91.6%)	1 (8.4%)	0 (%0)	
	5-10 years old	20 (80%)	3 (12%)	2 (%8)	
	≥10 years old	12 (85.7%)	2 (14.3%)	0 (%0)	
Gender	Male	77 (85.5%)	10 (11.1%)	3 (3.3%)	0.186
	Female	65 (76.4%)	18 (21.1%)	2 (2.3%)	
Stone size	Less than 3 mm	60 (85.7%)	9 (12.8%)	1 (1.4%)	0.934
	3 mm and above	87 (84.4%)	15 (14.5%)	1 (1.1%)	
UTI	Yes	69 (81.1%)	15 (17.6%)	1 (1.1%)	0.657
	No	74 (89.1%)	13 (15.6%)	1 (1.2%)	
Metabolic disorder	No	30 (85.7%)	5 (14.7%)	0 (0%)	0.572
	Single	84 (77.06%)	21 (19.2%)	4 (3.66%)	
	2 or 3	25 (86.2%)	3 (10.3%)	1 (3.44%)	
Metabolic disorder	Hypercalciuria	52 (71.2%)	18 (24.6%)	3 (4.10%)	0.314
	Hyperoxaluria	37 (78.7%)	8 (17.2%)	2 (4.25%)	0.835
	Hypocitraturia	31 (77.5%)	9 (22.5%)	0 (0%)	0.347
	Hyperuricosuria	8 (72.7%)	3 (27.2%)	0 (0%)	0.883

Chi-square test, UTI: Urinary tract infection

Table 7. Problem, code, f and anecdote			
Problem	Code	f	Anecdote
How do you generally feel during the day?	Generally I feel good	3	-Some days I feel very good, some days I feel bad -I usually feel good when I play
	I'm scared	7	-Sometimes I get excited, I'm scare -I'm scared my stomach will hurt -I'm afraid to move
	I'm in pain	5	-My waist hurts like someone hit it -My back hurts, I always want to lie down
	I feel weak	9	-I don't go play games with my friend -I get tired quickly when I go out
Can you describe the complaints you told your family about?	It burns when I go to the toilet	8	-Lately, it always burns when I pee -It burns when I pee at school
	I feel nauseous	6	-My stomach felt nauseous once in class -I always feel nauseous in the car
	My stomach hurts	8	-I told my mom my stomach hurts -I told my teacher my stomach hurts
	I can't sleep	4	-I can't sleep at night
Have you ever experienced a problem that you couldn't forget or bothered you a lot?	My friends laughed at me	3	-Once my pants got wet with pee, my friend laughed at me -My bed got wet with pee at night, my mom didn't get mad
	I was scared	6	-I was scared I wouldn't get better -I was scared the first time I came to the hospital
	It hurt badly	5	-Once when I was playing soccer, my stomach, legs, and back hurt a lot, my friends brought me home -My back hurt a lot at school, the principal called my dad
	I threw up	8	-Once I threw up at the playground, but I couldn't hold it in -I accidentally threw up in my brother's stroller

stone disease. It highlights the social and emotional toll the condition takes on young patients. Below is an interpretation based on the presented information.

Emotional and Physical Struggles

Fear and anxiety: The high frequency of the code "I'm scared" (7 occurrences) and the supporting anecdotes demonstrate that many children experience fear and anxiety related to their condition. Whether it is the fear of pain, or the fear of movement leading to more discomfort, the emotional weight is significant. This emotional burden, combined with the anecdotal evidence of their reactions ("I'm scared my stomach will hurt"), suggests that children feel vulnerable and anxious about unpredictable pain.

Physical pain: The recurring themes of pain, particularly the code "I'm in pain" (5 occurrences) and "It hurt badly" (5 occurrences), make it clear that the physical symptoms are overwhelming. Descriptions like "My waist hurts like someone hit it" and "Once my stomach, legs, and back hurt a lot" point toward the pervasive and multi-faceted nature of the pain these children experience. This also hints at the possible interruption of their daily activities, such as playing or attending school.

Nausea and weakness: Nausea and weakness appear in 6 and 9 cases, respectively, showing how this illness drains children's physical strength and well-being. The frequent mention of nausea during school or in cars indicates how the disease affects their daily routines, making even ordinary tasks challenging.

Social Impact

Isolation and embarrassment: Several children express feelings of embarrassment or humiliation. The code "My friends laughed at me" (3 occurrences) and associated anecdotes about bedwetting or accidents during school time illustrate how their condition can create social isolation. Being laughed at for something they cannot control (e.g., wetting themselves) not only reinforces their fear but also causes social discomfort, potentially affecting their self-esteem and peer relationships.

Support and understanding: Interestingly, some anecdotes reveal moments of emotional support, such as "My mom didn't get mad" when a child wet the bed. These moments, though few, suggest that family members or caregivers may play a role in buffering the emotional strain caused by these experiences. However, they also highlight the lack of broader social understanding from peers.

Cognitive Understanding of Their Condition

Incomprehension of severity: Some of the children's fears, such as "I was scared I wouldn't get better" and "I was scared the first time I came to the hospital," reveal a lack of understanding about their illness. This points to a gap in communication between healthcare providers, parents, and the child. Explaining the condition more thoroughly and in age-appropriate ways might alleviate some of this fear and anxiety.

Disruption of Daily Activities

Impact on sleep and play: The data shows that these children experience disrupted sleep, with 4 instances of "I can't sleep" and 9 instances of "I feel weak," revealing how the disease not only affects their physical activity but also compromises their rest. Given that play and sleep are essential for the cognitive and emotional development of children, the disruption of these activities may lead to further complications in their overall well-being.

DISCUSSION

Urolithiasis, though not life-threatening, can lead to long-term end-stage renal failure due to delays in diagnosis and treatment that impair kidney function.[19] According to the Turkish Society of Nephrology's 2008 data, urolithiasis was found in 3.3% of children starting renal replacement therapy.[3] Therefore, it is a condition with significant morbidity and recurrence effects, emphasizing the vital importance of early diagnosis and treatment. While research in this field has increased, studies on treatment and prognosis remain limited globally and in our country. This study provides essential information on treatment outcomes and the impact of age, stone size, and number on presenting complaints.[20]

This study revealed significant variations in presenting complaints based on age and stone size, with complaints such as macroscopic hematuria, dysuria, urinary incontinence, irritability, and pain showing notable associations with age at diagnosis. Pain was more prevalent with larger stones, while restlessness was more common with smaller stones. These findings are supported by qualitative data, where children frequently described pain as the most distressing symptom, particularly in older age groups, while younger children exhibited more emotional distress and irritability. The presence of single versus multiple stones significantly affected pain complaints but showed less variation in other symptoms.

Significant differences were found in the distribution of symptoms by age. Specifically, macroscopic hematuria, dysuria, urinary incontinence, irritability, and pain were more common in certain age groups. Macroscopic hematuria and dysuria were more frequently observed in older children (aged 5 and above), while irritability was more common in younger children (0-1 years). Pain was more frequently reported in children aged 5 years and above. The qualitative data further confirmed these age-specific patterns, as younger children expressed fear and anxiety, while older children were more focused on physical symptoms such as pain.In Chen et al.'s[21] study, it was noted that kidney stones caused age-related symptoms. Similarly, Matlaga et al.[22] highlighted that age played an important role in the severity and distribution of symptoms in pediatric patients. Sas et al.[23] further emphasized that the variety of symptoms increased with age, and metabolic factors varied based on age. However, Schaeffer et al.[24] reported that symptoms did not significantly differ between pediatric age groups, arguing that symptoms were similar across all ages.

A significant relationship between stone size and certain symptoms was observed. Larger stones (>3 mm) were

associated with more frequent complaints of pain, while smaller stones (<3 mm) were more commonly linked to irritability. Urinary incontinence was also more frequently observed in cases with larger stones. Qualitative findings supported these results, with children describing larger stones as a source of severe pain. Xu et al.[6] reported that stone size was related to metabolic changes, with larger stones causing more severe symptoms. Demirtas et al.[5] emphasized that larger stones directly affected the treatment process and the severity of symptoms. Klib et al.[25] also noted that stone size played a key role in determining the severity of symptoms. In contrast, Kirkali et al.[26] found no significant relationship between stone size and symptom severity, suggesting that the patient's overall condition and metabolic characteristics were more critical than the stone size in determining symptoms.

Pain complaints were more common in cases with a single stone compared to multiple stones. No significant differences were found in other symptoms (nausea, vomiting, stone passage, macroscopic hematuria, dysuria) between cases with single or multiple stones. This was consistent with children's narratives in the qualitative portion, where they frequently mentioned pain as their primary concern, especially in single stone cases. Demirtas et al.[5] also studied the effect of stone count on clinical symptoms and reached similar conclusions. However, Schaeffer et al.[24] suggested that multiple stones, especially in cases with metabolic risk factors, could lead to different clinical presentations.

Among the metabolic disorders, hypercalciuria was the most common, observed in 36.2 % of cases. Hypercalciuria and hyperoxaluria were the most frequently co-occurring metabolic disorders. No cases of cystinuria were detected. In Spivacow et al.'s[27] study, hypercalciuria and hyperoxaluria were also reported as the most common risk factors in children. Sarica's[28] study highlighted the critical role of genetic and metabolic factors in pediatric stone formation. However, Rizvi et al.[29] reported that cystinuria, a rare metabolic disorder, was observed at a higher rate than expected in pediatric urolithiasis cases. While our study found no cystinuria cases, Rizvi's[29] findings indicate that rare metabolic disorders may be more prevalent in broader populations.

The majority of cases (89.1%) were managed with medical treatment, and 85.7% of patients achieved complete recovery. Surgical treatment and ESWL were reserved for more complex cases. The recurrence rate was found to be 2.8%, indicating a low rate of recurrence. This low recurrence rate emphasizes the effectiveness of medical management in most pediatric urolithiasis cases. Öner et al.'s[8] study similarly reported that medical management is the primary approach for pediatric stone disease, with surgical interventions reserved for more complicated cases. Kirkali et al.'s[26] study also supported the preference for minimally invasive surgical procedures in more complex stone cases. Chen et al.[21] compared the effectiveness of surgical and medical treatment methods for kidney stones and concluded that medical management is preferred in most cases.

The emotional and social impacts of the disease on children were evident, with symptoms such as fear, isolation, shame, and disruption of daily activities being observed. Qualitative data enriched our understanding of these psychosocial effects, revealing that children with urolithiasis not only experience physical discomfort but also significant emotional stress. Ayyad et al.[30] also reported that the quality of life for children with kidney stones was negatively affected by such social and emotional factors. Culhane-Pera and Lee's[31] study, which explored kidney stone patients within the Hmong community, emphasized the social and emotional consequences of the disease on children. Klib et al.[25] also highlighted similar social and emotional effects, stressing the importance of emotional support during this process.

The patient's age and stone size are important factors in clinical evaluation and treatment planning. The higher frequency of certain symptoms in specific age groups suggests that age-specific treatment strategies are needed. The alignment of qualitative and quantitative findings in this study reinforces the importance of a holistic approach to patient care, considering both physical and emotional factors in managing pediatric urolithiasis. Sarica[28] found similar results, noting that age-specific pathophysiological differences should be considered in treatment strategies. Issler et al.[32] also emphasized the importance of age in clinical management, noting that symptoms and treatment approaches vary by age group. Similarly, Coward et al.[33] reported that the distribution of symptoms and treatment approaches varied significantly depending on the age of the child.

All children with urinary stone disease deserve a meticulous risk factor assessment that forms the basis of personalized and targeted treatment. Early diagnosis and appropriate treatment selection are crucial in managing stone disease. Regular urological examinations are necessary for high-risk groups, such as those with a family history, to enhance awareness and effectiveness of early diagnosis and treatment. Further comprehensive genetic research on stone disease will enhance understanding and support the development of personalized treatment approaches. The findings of this study can serve as an important reference for clinicians and health policymakers, aiding in the development of strategies for the management and prevention of stone disease.

CONCLUSION

This study highlights the significant impact of urolithiasis on children, emphasizing the importance of early diagnosis and tailored treatment strategies to prevent long-term complications, including end-stage renal failure. The findings demonstrate that presenting symptoms such as hematuria, dysuria, urinary incontinence, irritability, and pain vary with age, stone size, and the presence of single or multiple stones. Metabolic risk factors, particularly hypercalciuria and hyperoxaluria, were identified as the most common contributors to stone formation, with no cases of cystinuria detected in this study.

Medical management remains the primary treatment approach, with surgical interventions, including minimally invasive endoscopic surgeries and extracorporeal shock wave lithotripsy (ESWL), being reserved for more complex cases. The study also underscores the importance of genetic and

metabolic assessments to provide personalized treatment plans, especially for children with a family history of stone disease or consanguineous marriages, who are at higher risk.

The analysis of the chief complaints and experiences shared by children suffering from kidney stones shows that they endure not only physical discomfort but also significant emotional and social challenges. These experiences, including feelings of fear, embarrassment, and isolation, are compounded by the condition's disruption of their normal activities like playing, sleeping, and attending school. Support systems, both within the family and socially, can play a crucial role in mitigating these challenges, but there appears to be room for improvement in educating children about their condition and fostering a more supportive environment both at home and among peers.

Given the rising prevalence of urolithiasis in Turkiye and neighboring regions, future research should focus on genetic predispositions and more advanced diagnostic and treatment options. Regular follow-ups, metabolic evaluations, and preventive measures in high-risk groups are essential for improving clinical outcomes and reducing recurrence rates. The insights from this study can serve as a valuable reference for clinicians and policymakers, helping to refine strategies for managing and preventing pediatric urolithiasis effectively.

ETHICAL DECLARATIONS

Ethics Committee Approval
The study was conducted with the permission of the Samsun University Non-interventional Clinical Researches Ethics Committee (Date: 14.08.2024, Decision No: 2024/14/2).

Informed Consent
Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process
Externally peer-reviewed.

Conflict of Interest Statement
The authors have no conflicts of interest to declare.

Financial Disclosure
The authors declared that this study received no financial support.

Author Contributions
All authors declare that they participated in the design, execution, and analysis of the study and have approved the final version.

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