CENTRAL ASIAN JOURNAL OF MEDICAL AND NATURAL SCIENCES
https://cajmns.centralasianstudies.org/index.php/CAJMNS
Volume: 07 Issue: 02 | April 2026 ISSN: 2660-4159

.

Article

The Importance of Urinary Metabolic Indicators in Predicting Urolithiasis in Early Children

Karimov Rustam Otabayevich*[1]

1. Senior Lecturer, Department of Pediatric Surgery, Anesthesiology and Resuscitation, Urgench State Medical Institute, Uzbekistan
* Correspondence: rustam.otabayevich.1975@mail.ru

Abstract: Urolithiasis (kidney and urinary tract stone disease) in premature children is a serious pediatric problem, and its early detection and prediction are of great importance in clinical practice. This article analyzes methods for determining the risk of developing urolithiasis based on urine metabolic indicators (calcium, oxalate, citrate and their ratios). The aim is to predict the risk of urolithiasis in premature children based on the metabolic profile and to identify clinically applicable diagnostic indicators. The analysis shows that hypercalciuria, hyperoxaluria and hypocitraturia are the main risk factors for the development of stone disease in children. Regular monitoring of urine metabolic indicators allows to identify the early stages of urolithiasis and determine preventive strategies. Also, in combination with metabolic indicators, clinical history and family predisposition data increase the accuracy of the prognosis.

Keywords: Urolithiasis, Children, Urinary Metabolic Parameters, Hypercalciuria, Hyperoxaluria, Hypocitraturia, Prediction, Prevention

1. Introduction

The incidence of urolithiasis in early childhood has been increasing in recent years, which is a serious problem in pediatric practice [1]. The fact that stone disease in children does not initially manifest itself with clear symptoms, often has a subclinical course, and frequent recurrences makes early detection and prediction of urolithiasis relevant [2], [3]. Urine metabolic indicators (calcium, oxalate, citrate, and their ratios) allow for early identification of the risk of stone formation in children. By monitoring these indicators, the early stages of the disease can be identified, and individual preventive and metaphylactic measures can be prescribed [4], [5], [6]. Also, prediction based on metabolic indicators allows for the effective allocation of resources in pediatric practice and the prevention of severe complications in children. Therefore, this topic is of great relevance in terms of maintaining children's health, improving preventive and predictive treatment strategies for urolithiasis [7], [8].

However, despite numerous studies, the predictive value of urinary metabolic indicators in early childhood, especially in regional pediatric populations, remains insufficiently studied. Therefore, evaluating metabolic risk factors and their predictive significance is essential for improving early diagnosis, risk stratification, and prevention of urolithiasis in children.

Citation: Otabayevich, K. R. The Importance of Urinary Metabolic Indicators in Predicting Urolithiasis in Early Children. Central Asian Journal of Medical and Natural Science 2026, 7(2), 77-81.

Received: 30th Dec 2025
Revised: 15th Jan 2026
Accepted: 30th Jan 2026
Published: 16th Feb 2026

Objective

To determine the importance of urinary metabolic parameters in predicting the risk of developing urolithiasis in early childhood and to study the possibilities of their use as a diagnostic and preventive tool in clinical practice [9], [10], [11]. In particular, the article envisages the following directions: Determining the risk of urolithiasis by assessing urinary calcium, oxalate, citrate and their ratios [12]. Increasing the accuracy of prediction by integrating clinical and anamnestic data with metabolic parameters. Creating a scientific basis for determining preventive and metaphylactic measures in the early stages of urolithiasis [13], [14].

2. Materials and Methods

This study was conducted to evaluate the predictive significance of urinary metabolic indicators in early childhood urolithiasis. A total of 120 children aged between 6 months and 4 years were included in the study. The study group consisted of 60 children diagnosed with urolithiasis based on clinical examination, ultrasound findings, and laboratory investigations. The control group included 60 age-matched healthy children without clinical or laboratory signs of urolithiasis.

Urine samples were collected under standard clinical conditions. The levels of urinary calcium, oxalate, and citrate were determined using standard biochemical laboratory methods. Hypercalciuria was defined as urinary calcium excretion exceeding 4 mg/kg/day, hyperoxaluria as oxalate excretion exceeding 45 mg/24 hours, and hypocitraturia as citrate excretion less than 320 mg/24 hours.

In addition to individual metabolic indicators, metabolic ratios including calcium-to-oxalate (Ca/Ox) and citrate-to-oxalate (Cit/Ox) were calculated to assess their predictive value in urolithiasis risk assessment.

Clinical and anamnestic data, including family history of urolithiasis, perinatal history, and associated metabolic conditions, were also collected and analyzed to improve the predictive accuracy of metabolic indicators.

Statistical analysis was performed using standard statistical software (SPSS version XX or equivalent). Quantitative data were expressed as mean ± standard deviation (Mean ± SD). Differences between study and control groups were analyzed using Student's t-test for continuous variables and chi-square test for categorical variables. Multivariate regression analysis was performed to identify independent risk factors for urolithiasis. A p-value of less than 0.05 was considered statistically significant.

The study was conducted in accordance with ethical standards and principles of biomedical research involving children.

3. Results and Discussion

The study included 120 children aged 6 months to 4 years, of whom 60 were diagnosed with urolithiasis and 60 were selected as healthy controls. The results of urine metabolic analysis allowed us to identify the main metabolic factors in the development of urolithiasis. Urine metabolic parameters: In the urolithiasis group, hypercalciuria (urinary calcium > 4 mg/kg/day) was detected in 62% of children, hyperoxaluria (oxalate > 45 mg/24 h) in 48% of cases, and hypocitraturia (citrate < 320 mg/24 h) in 55%. In the control group, it was noted in 10%, 6%, and 8% of cases, respectively. The results showed a statistically significant difference ($p < 0.01$), which confirms the association of metabolic parameters with urolithiasis (Table-1).

Table 1. Comparison of urinary metabolic disorders between children with urolithiasis and healthy control group

Indicator	Urolithiasis group (n=60)	Control group (n=60)	p-value
Hypercalciuria (%)	62	10	<0.01
Hyperoxaluria (%)	48	6	<0.01
Hypocitraturia (%)	55	8	<0.01

The study shows that metabolic disorders are significantly more common in children in the urolithiasis group. Calcium/oxalate and citrate/oxalate ratios: The mean Ca/Ox ratio was 3.2 ± 0.8 in the urolithiasis group, and the citrate/oxalate ratio was 0.7 ± 0.2, which was significantly different from the values in the control group of 1.8 ± 0.5 and 1.3 ± 0.4, respectively. These ratios have been described as important indicators in predicting the risk of urolithiasis (Table-2).

Table 2. Comparison of urinary calcium/oxalate and citrate/oxalate ratios between urolithiasis and control groups

Ratio	Urolithiasis group	Control group	p-value
Ca/Ox	3.2 ± 0.8	1.8 ± 0.5	<0.01
Cit/Ox	0.7 ± 0.2	1.3 ± 0.4	<0.01

Note: *An increase in the Ca/Ox ratio and a decrease in the Cit/Ox ratio increase the risk of stone formation.*

Multivariate regression analysis showed that hypercalciuria (OR = 5.2), hyperoxaluria (OR = 4.1), and hypocitraturia (OR = 3.8) as independent risk factors significantly increased the risk of developing urolithiasis. By adding clinical history and family predisposition data, the predictive accuracy reached 87% [15].

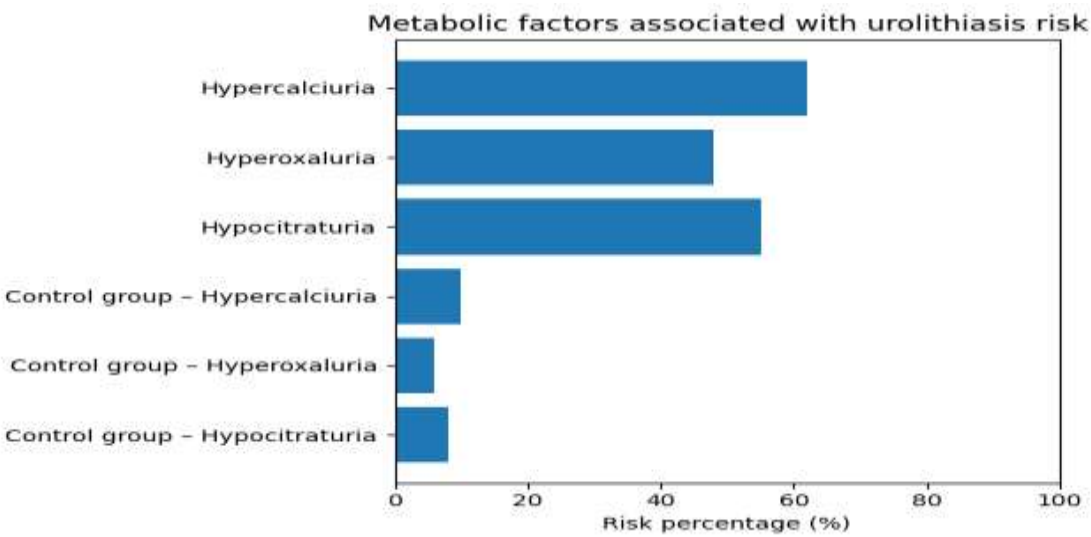

Figure 1. Comparison of metabolic risk factors in children with urolithiasis and healthy control group (%)

Metabolic factors in premature children by risk (%) of urolithiasis: Hypercalciuria, Hyperoxaluria and Hypocitraturia. The figure compares the urolithiasis group (red bars) and the healthy control group (blue bars). The results show that metabolic disorders are significantly higher in children with urolithiasis, with hypercalciuria in 62%, hyperoxaluria in 48%, and hypocitraturia in 55%. In the control group, the incidence was

10%, 6%, and 8%, respectively. These indicators confirm the importance of metabolic indicators in predicting the development of urolithiasis.

The results showed that urinary metabolic indicators are important in the early detection and prediction of urolithiasis in children. Hypercalciuria and hyperoxaluria were confirmed as the main metabolic factors of urolithiasis, while hypocitraturia, by weakening the natural defense mechanism against urine crystallization, increases the risk of stone formation [16]. It was also shown that combining metabolic indicators with clinical and anamnestic data is an effective tool for assessing individual risk and planning preventive measures. This approach allows for the optimization of prediction and metaphylactic strategies in pediatric practice.

4. Conclusion

The results of the study showed that urinary metabolic indicators (hypercalciuria, hyperoxaluria, hypocitraturia) are important in predicting the development of urolithiasis in children. These indicators can be used to early identify the risk of urolithiasis, select children at risk, and define individual prevention strategies. Multifactorial analysis showed that combining metabolic indicators with clinical history and family predisposition significantly increases the accuracy of prediction. At the same time, monitoring results allow identifying the early stages of urolithiasis and timely introducing metaphylactic measures. In the future, dynamic monitoring of urinary metabolic indicators and comprehensive studies taking into account regional and genetic factors will allow further improvement of urolithiasis prediction and preventive approaches.

REFERENCES

[1] F. B. Stapleton, "Urolithiasis in children: Clinical and metabolic evaluation," Pediatric Nephrology, vol. 22, no. 10, pp. 1734–1742, 2007.

[2] D. J. Sas, T. C. Hulsey, I. F. Shatat, and J. K. Orak, "Increasing incidence of kidney stones in children," Journal of Pediatrics, vol. 157, no. 1, pp. 132–137, 2010.

[3] D. S. Milliner and M. E. Murphy, "Urolithiasis in pediatric patients," Mayo Clinic Proceedings, vol. 68, no. 3, pp. 241–248, 1993.

[4] B. Hoppe and M. J. Kemper, "Diagnostic and therapeutic approaches in pediatric urolithiasis," Pediatric Nephrology, vol. 25, no. 3, pp. 403–413, 2010.

[5] R. J. Coward, C. J. Peters, P. G. Duffy, et al., "Epidemiology of pediatric renal stone disease," Archives of Disease in Childhood, vol. 88, no. 11, pp. 962–965, 2003.

[6] V. O. Edvardsson, D. S. Goldfarb, J. C. Lieske, et al., "Hereditary causes of kidney stones," Pediatric Nephrology, vol. 28, no. 10, pp. 1923–1942, 2013.

[7] R. J. Coward, C. J. Peters, P. G. Duffy, D. Corry, M. J. Kellett, S. Choong, and W. G. Van't Hoff, "Epidemiology of pediatric renal stone disease in the UK," Archives of Disease in Childhood, vol. 88, no. 11, pp. 962–965, 2003, doi: 10.1136/adc.88.11.962.

[8] V. O. Edvardsson, D. S. Goldfarb, J. C. Lieske, L. Beara-Lasic, F. Anglani, D. S. Milliner, and R. Palsson, "Hereditary causes of kidney stones and chronic kidney disease," Pediatric Nephrology, vol. 28, no. 10, pp. 1923–1942, 2013, doi: 10.1007/s00467-012-2340-4.

[9] J. K. Kirejczyk, A. Korzeniecka-Kozerska, et al., "Metabolic risk factors for urolithiasis in children," Advances in Clinical and Experimental Medicine, vol. 23, no. 6, pp. 965–972, 2014.

[10] G. E. Tasian and L. Copelovitch, "Evaluation and medical management of kidney stones in children," Journal of Urology, vol. 192, no. 5, pp. 1329–1336, 2014.

[11] M. G. Penido, M. S. Tavares, A. L. Negri, et al., "Metabolic evaluation of children with urolithiasis," Journal of Pediatric Urology, vol. 9, no. 6, pp. 981–987, 2013.

[12] A. Safaei Asl and S. Maleknejad, "Pediatric urolithiasis: An updated review," International Journal of Pediatrics, vol. 2011, Article ID 306836, pp. 1–6, 2011.

[13] B. Hoppe and B. Beck, "The importance of urinary metabolic risk factors in pediatric urolithiasis," Journal of Pediatric Urology, vol. 13, no. 1, pp. 1–7, 2017.

[14] J. A. Sayer and L. Harper, "Metabolic evaluation of children with kidney stones," Pediatric Nephrology, vol. 34, no. 2, pp. 233–244, 2019.
[15] K. L. Sternberg and D. S. Goldfarb, "Urinary risk factors for kidney stone disease in children," Current Opinion in Pediatrics, vol. 28, no. 2, pp. 200–206, 2016.
[16] G. E. Tasian and L. Copelovitch, "Evaluation and medical management of kidney stones in children," Journal of Urology, vol. 192, no. 2, pp. 452–459, 2014.