

## Comparison of urinary sodium and potassium in children older than two with idiopathic hypercalciuria and a healthy control group in Bandar-Abbas, Iran, in 2013

Elham Ajdadi<sup>1</sup>, Maryam Esteghamati<sup>2</sup>, Kambiz Ghasemi<sup>2</sup>, Samira Zakeri Shahvari<sup>3</sup>

<sup>1</sup>. Pediatric diseases resident, Infectious and Tropical Diseases Research Center, Hormozgan University of Medical Sciences, Bandar Abbas, Iran.

<sup>2</sup>. Pediatric nephrologist, Department of Pediatrics Nephrology, Clinical Research Development Center of Children Hospital, Hormozgan University of Medical Sciences, Bandar Abbas, Iran.

<sup>3</sup>. Specialist in pediatric diseases, Clinical Research Development Center of Children Hospital, Hormozgan University of Medical Sciences, Bandar Abbas, Iran.

### Corresponding Author:

Dr Maryam Esteghamati, Pediatric nephrologist, Department of Pediatrics Nephrology, Clinical Research Development Center of Children Hospital, Hormozgan University of Medical Sciences, Bandar Abbas, Iran. Tel: +98.9123866020, Fax: +98.07613337192, Email: [maryamesteghamati@yahoo.com](mailto:maryamesteghamati@yahoo.com)

### Abstract

**Background:** Idiopathic hypercalciuria is an important cause of symptoms related to the urinary system. The urinary excretion of high sodium and low potassium is a risk factor for hypercalciuria and urolithiasis. The aim of this study was to compare the urinary excretion of sodium and potassium by children older than two with idiopathic hypercalciuria and healthy control children in Bandar-Abbas, Iran.

**Methods:** This case control study was conducted during 2012 and 2013 in Bandar-Abbas, a city in southern Iran. The urinary excretion of sodium and potassium by 50 children with idiopathic hypercalciuria who were older than two was compared with that of 62 healthy children. IBM SPSS Statistics 21 software was used to analyze the data, and  $P < 0.05$  was considered to be significant.

**Results:** Fifty children with idiopathic hypercalciuria (21 males and 29 females) were compared with 62 healthy children (19 males and 43 females). The results of the study indicated that there were no significant differences in the mean sodium and potassium levels in the urine of the two groups of children ( $P = 0.401$  and  $P = 0.479$ , respectively.)

**Conclusion:** The study showed no significant differences in the excretion of sodium and potassium in the urine of children with idiopathic hypercalciuria and that of healthy children in Bandar-Abbas. This finding was inconsistent with the results of similar studies conducted earlier. Therefore, more studies are needed on populations in different areas with various climates and difference races.

**Keywords:** idiopathic hypercalciuria, urine, sodium, potassium

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## 1. Introduction

### 1.1. Background

Idiopathic hypercalciuria is a common metabolic disorder of the kidneys that results in urolithiasis (1), which is defined as increased excretion of calcium in the urine in the absence of hypocalcemia or any other causes of hypercalciuria (2). There is a significant prevalence of idiopathic hypercalciuria in asymptomatic children, and this condition is diagnosed extensively in children with symptoms related to the urinary system (3).

## 1.2. Statement of Problem

To determine the excretion of Ca in the urine accurately, urine output must be collected over a 24-hour period, but this is difficult to do with small children. Therefore, several studies have reported that the calcium to creatinine ratio (Ca/Cr) in urine is accurate enough to be used as an alternative to collecting urine from children over a 24-hour period (4, 5). A Ca/Cr ratio in urine of 0.21 or greater is considered to be the cut-off point for this test (1). Children with higher measures are suspected of having idiopathic hypercalciuria. Although these patients are often asymptomatic, they may present with dysuria, frequency of urination, urolithiasis, enuresis, and other symptoms related to the urinary system (6, 7). The excretion of Ca in urine is influenced by ethnicity, nutrition, water consumption, geographical area, and exposure to sunlight (6). The amount of Ca excreted in the urine is influenced by other electrolytes, such as potassium, sodium, and phosphorus and by other factors, such as the amount of protein intake. Tubular Ca absorption can be inhibited by increasing the amount of oral or intravenous sodium chloride intake. Also, it seems that an increase in the K intake may be beneficial for children with idiopathic hypercalciuria (8-10). However, the results of studies concerning the levels of urinary excretion of Na and K by children with idiopathic hypercalciuria are inconsistent. Therefore, the levels of Na and K excreted in the urine should be measured in patients with idiopathic hypercalciuria to aid in the achievement of diagnostic and therapeutic objectives.

## 1.3. Objectives

The general objective of this study was to compare the quantities of sodium and potassium excreted in the urine of children older than two who have idiopathic hypercalciuria in the urine of a control group of healthy children in Bandar-Abbas, Iran. The following are the specific objectives of the study:

- To compare the urinary Na excretion in children with idiopathic hypercalciuria with that of healthy children
- To compare the urinary K excretion in children with idiopathic hypercalciuria with that of healthy children
- To compare the urinary Na/K excretion ratio in children with idiopathic hypercalciuria with that of healthy children
- To compare the urinary Na/Cr excretion ratio in children with idiopathic hypercalciuria with that of healthy children
- To compare the urinary K/Cr excretion ratio in children with idiopathic hypercalciuria with that of healthy children

## 2. Material and Methods

### 2.1. Study settings

This case-control study was conducted during 2012 and 2013. Fifty children who ranged in age from two to 14 with confirmed idiopathic hypercalciuria and 62 healthy children in the same age range were enrolled in the study. The Bandar-Abbas Children's Hospital is the main educational and referral hospital in the field of pediatric disease, and it was the nephrology clinics in this Hospital that confirmed idiopathic hypercalciuria in the case group of children.

### 2.2 Sample size

Considering the difference of 1.1 mmol/kg/day of Na excreted in the urine of the two groups of children, the standard deviation of 1.4, and 2.3 mmol/kg/day of Na excreted by children with idiopathic hypercalciuria and children in the healthy group in previous studies (11), it was calculated that the sample size had to be at least 49 children in each group (Type I error = 0.05 and type II error = 0.20).

### 2.3. Case selection

The case group was selected among children in the age range of two to 14 who had confirmed idiopathic hypercalciuria. The ages of the children selected for the control group were in the same range as those in the case group. A written informed consent was obtained from the parents of the children. The exclusion criteria of study were thyroid and parathyroid disorders, renal tubular acidosis, chronic renal failure, chronic bone disease, and the use of drugs that alter the metabolism of bone, such as corticosteroids, diuretics, and anticonvulsants.

### 2.4. Laboratory tests

Urine samples were analyzed for sodium and potassium with an ion-selective electrode Easy life device. Calcium in the urine was measured with a photometric method by using the ARSENASO III, and the creatinine in the urine was measured with the JAFFE method with a wavelength of 50 nm. The reference value for Na was less than 2.3 mg/dl, the reference value for K was more than 3.91 mg/dl, and the Na/K ratio was in the range of 0.5-2.5 mmol/day.

## 2.5. Statistical analysis.

The data were analyzed using IBM SPSS Statistics 21 software and descriptive statistics (mean, standard deviation, and frequency), the Shapiro-Walik test (for the assessment of the normality of the distribution of Na, K, Na/K, Na/Cr, and K/Cr in the urine), independent Samples T test (to compare the Na excreted in the urine of the two groups), and the Mann-Whitney test (to compare the excretion of K, Na/K, Na/Cr, and K/Cr in the urine of the two groups). Also the chi-square test was used to compare qualitative variables between the two groups. P values < 0.05 were assumed to be significant.

## 3. Results

One hundred and twelve children were enrolled in this study, including 40 males (35.7%) and 72 females (64.3%). The children were divided into three separate age groups. Sixty-seven of the children (59.8%) were between two and six years old. Also, 32 of the children (28.6%) were between six and 10 years old, and 13 (11.6%) were between 10 and 14 years old.

The mean K level was  $58.81 \pm 46.08$  mEq/L, and the K level was not normally distributed among the study's participants (Shapiro-Wilk test P value < 0.01). Also the mean sodium excretion in urine was  $132.62 \pm 68.92$  mEq/L, and it was normally distributed among the study's participants (Shapiro-Wilk test P value = 0.135).

Table 1 shows that the two groups were similar based on gender and age groups. The excretion of Na and K and Na/K ratio in the urine were not significantly different between the two study groups. However, the Na/Cr and K/Cr ratios were significantly greater in the children who had idiopathic hypercalciuria than they were in the control group. Details are shown in Table 2 and Table 3.

**Table 1.** Frequency of different genders and age groups in study groups

		Control n(%)	Case n(%)	Chi-Square P value
Gender	Male	19 (30.6%)	21 (42%)	0.212
	Female	43 (69.4%)	29 (58%)	
Age group	2-6	38 (61.3%)	29 (58%)	0.732
	6-10	16 (25.8%)	16 (32%)	
	10-14	8 (12.9%)	5 (10%)	

**Table 2.** Comparison of urine Na excretion between case and control group

		n	Mean $\pm$ SD	Independent Samples T test P value
Urine Na excretion	Control	62	137.56 $\pm$ 73.59	0.401
	Case	50	126.50 $\pm$ 62.85	

**Table 3.** Comparison of urine K, Na/K, Na/Cr, and K/Cr excretion between case and control group

		n	Mean Rank	Sum of ranks	Mann-Whitney test P value
Urine K excretion	Control	62	54.55	3382	0.479
	Case	50	58.92	2946	
Urine Na/K excretion ratio	Control	62	60	3720	0.204
	Case	50	52.16	2608	
Urine Na/Cr excretion ratio	Control	62	48.09	2981.50	0.002
	Case	50	66.93	3346.50	
Urine K/Cr excretion ratio	Control	62	48.78	3024.50	0.005
	Case	50	66.07	3303.50	

## 4. Discussion

### 4.1. Level of Na excreted in urine

The finding in our study showed no significant difference in the amount of Na excreted in the urine of the children with and without idiopathic hypercalciuria. This finding was in disagreement with the findings of Rodríguez et al. (12), Kovacevic (13, 14), Polito (11), and Honarpisheh (15), all of whom reported increased levels of sodium excreted in the urine of hypercalciuric children. These findings do not support our hypothesis about the difference between urinary excretions of Na and K in children with and without idiopathic hypercalciuria. Several factors may

have affected our results. Nutritional and climate factors are important variables that could account for the differences between our results and the results of similar studies.

#### **4.2. Excretion level of K in urine**

We found no significant difference in the levels of excreted K in the urine of children with and without idiopathic hypercalciuria. This finding was in disagreement with the finding of Rodríguez et al. (12). In the Polito study in 2002 (11), there was no difference in the excretion of potassium in the urine of hypercalciuric and healthy children; our findings were in agreement with these results. The results of various studies on the excretion of K in urine are inconsistent. In addition to climate and nutritional variations, body mass index is also an important factor that potentially could alter the amount of K excreted. Also, the male to female ratio have a significant effect on the amount of K excreted in urine due to the greater body mass index and muscular mass among the males.

#### **4.3. Excretion levels of Na/K in urine**

Based on our findings, there was no significant difference in the Na/K excretion ratio between children with idiopathic hypercalciuria and the healthy children in the control group. Although most studies have reported higher levels in children with idiopathic hypercalciuria, some studies have reported lower levels in such children (16). As discussed above, there are some controversies about the levels of the NA/K ratio in normal children and children with idiopathic hypercalciuria. Therefore, studies with larger sample sizes are needed in different areas and for different races.

#### **4.4. Excretion levels of Na/Cr and K/Cr in urine**

In our study, the Na/Cr excretion ratio in urine was greater in children with idiopathic hypercalciuria than in the children in the control group. The results of our study showing that there was a direct relation between the Ca/Cr ratio and the Na/Cr ratio in urine were compatible with the results of a study conducted by Erol et al. in 2001-2002 in Turkey (17). Our results showed that patients with idiopathic hypercalciuria had greater K/Cr ratios in their urine than the children in the healthy control group, but this finding was not compatible with the findings by other researchers who have reported lower K excretion in children with idiopathic hypercalciuria (12).

Various studies have shown that the Na/Cr ratio is greater in the urine of children with idiopathic hypercalciuria. However, our results are not compatible with this, and we recommend more studies to confirm these results.

### **5. Conclusions**

The study showed no significant difference in the excretion of sodium and potassium in the urine of idiopathic hypercalciuria and the urine of the healthy children in the control group in Bandar-Abbas. The results of our study could have been affected by nutrition and geographical variations in the different areas. Therefore, more studies are needed in this field in different areas in Iran.

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#### **Conflict of Interest:**

There is no conflict of interest to be declared.

#### **Authors' contributions:**

All of authors contributed to this project and article equally. All authors read and approved the final manuscript.

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