

# Normal calcium, sodium and potassium to creatinine ratio in Babol healthy adolescents

## Original Article

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## Abstract:

**Background:** Due to difficulty of obtaining a 24h urine (especially in children), a random urine calcium sample is recommended to detect of hypercalciuria. However, recent studies have shown that the urinary calcium/creatinine ratio varies with age and geographic areas. So, the aim of this study was determining the normal value of urinary calcium to creatinine ratio in healthy adolescent's children.

**Methods:** Four hundred eight children of 12 to 14-year-old were randomly selected from middle school in Babol (north of Iran) and early morning urinary samples of them were studied for determining normal urine Ca/Cr, Na/Cr and K/Cr ratios. Children who had the family with the history of renal disease were excluded from this study.

**Results:** In this study the 50% and 95% of urinary Ca/Cr ratio were  $0.08 \pm 0.02$  and  $0.13 \text{ mg/mg}$  for the whole group. The mean of urinary Ca/Cr ratio in boys and girls were  $0.08 \pm 0.03$  and  $0.08 \pm 0.02$ , respectively. The mean of urinary Na/Cr ratio in boys was  $1.4 \pm 0.48$  and in girls was  $1.21 \pm 0.33$ . Also, the mean of urinary K/Cr ratio in boys and girls were  $0.30 \pm 0.11$  and  $0.29 \pm 0.10$ , respectively.

**Conclusions:** This study was shown that the urinary Ca/Cr ratio of these children is different from other geographic areas. Also, a direct relationship was seen between urinary Ca/Cr ratio, Na/Cr and k/Cr ratios.

**Keywords:** Adolescents, Normal Urinary Calcium Creatinine Ratio, Normal Urinary Sodium Creatinine Ratio, Normal Urinary Potassium Creatinine Ratio

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## Introduction:

Kidney is a one of the most important organs that responsible for homeostasis of calcium ion <sup>[1]</sup>. So, the increase in loss of calcium in urine (hypercalciuria) is very important because the risk of renal stone and also frequency, dysuria, enuresis hematuria and abnormal pain were increased <sup>[2, 3]</sup>. More than 4 mg/kg/day of calcium in 24-hour urine were determined hypercalciuria <sup>[4, 5]</sup>, but 24-hour urine collection in children was difficult and may be not reliable. There are many studies that recommended using the spot urine for detection of hypercalciuria. They used random urine calcium to creatinine ratio (U Ca/Cr) for screen of hypercalciuria. But according to different ages and geographic area, this ratio is varied <sup>[6-12]</sup>. Also, Osorio et al.'s reported the relationship of U Ca/Cr ratio with urine sodium to potassium ratio (U Na/K ratio) <sup>[13]</sup>, but in So et al.'s study, there wasn't significant relationship between U Ca /Cr and U Na/K <sup>[10]</sup>. So, this study was done on adolescents in the north of Iran to determine the normal U Ca/Cr ratio and also the relationship with Na/Cr and k/Cr ratios.

## Methods:

This prospective study was done on children from 12-14 years of age in Babol (north of Iran, near Caspian Sea).

**Case Selection:** Four hundred eighty children (from 12-14 years old) were randomly selected from 10 high schools (5 for girls and 5 for boys). The weight and length of them were measured to rule out the failure for thriving. All of them had normal blood pressure according to age and sex.

Children with history of kidney disease in them and their family were excluded. Then early morning urinary samples were taken for measurement of calcium, creatinine, sodium and potassium.

**Urine examination:** Urine calcium, creatinine, sodium and potassium were measured by Kinetic Jaffe reaction, complexometry by ortocrosol fetalin and flame photometry, respectively. Then the ratios of urine Ca/Cr (mg/mg), Na/Cr (mEq/lit/mg), K/Cr (mEq/lit/mg) ratio were calculated.

**Statistical analysis:** Data were analyzed by Student T-test, analysis of variance (ANOVA) and Pearson coefficient and the significance was considered  $p < 0.05$ .

## Results:

Among 480 Children, 72 people were excluded. Two hundred twenty five Children were girls and 183 cases were boys. Mean ratio of U Ca/Cr in all children was  $0.08 \pm 0.02$  and 95% of it was 0.13. This ratio was more in children with the age of 13 and less in children of 14 (table 1). Also, in all age groups, this ratio was more in girls than boys but there was no significant difference ( $p > 0.05$ ). The mean ratio of U Na/Cr in all children was  $1.3 \pm 0.43$  and was more in 13-year-old group and less in 14 years old (table 2). U Ca/Cr ratio the same as U Na/Cr ratio was more in girls than boys but not significant ( $p > 0.05$ ). Mean and 95% of U K/Cr ratio in all children were  $0.29 \pm 0.1$  and 0.52, respectively. It was more in 12-year-old group and less in 14 one (table 3). There was significant difference between Ca/Cr, Na/Cr and K/Cr ratio ( $p \leq 0.05$ ).

**Table 1- Mean and 95% of random urine calcium to creatinine ratio in children 12-14 years old**

Age Groups (years)	Sex	Number	Mean $\pm$ SD	95%	Total	Mean $\pm$ SD	95%
12	Girls	76	$0.08 \pm 0.03$	0.13	137	$0.76 \pm 0.02$	0.12
	Boys	61	$0.08 \pm 0.02$	0.12			
13	Girls	77	$0.08 \pm 0.03$	0.15	141	$0.08 \pm 0.03$	0.14
	Boys	64	$0.08 \pm 0.02$	0.13			
14	Girls	72	$0.08 \pm 0.02$	0.12	130	$0.07 \pm 0.02$	0.12
	Boys	58	$0.07 \pm 0.02$	0.12			
Total					408	$0.08 \pm 0.02$	0.13

**Table 2- Mean and 95% of random urine Sodium to creatinine ratio in children 12-14 years old**

Age Groups (years)	Sex	Number	Mean $\pm$ SD	95%	Total	Mean $\pm$ SD	95%
12	Girls	76	$1.36 \pm 0.48$	2.25	137	$1.30 \pm 0.41$	2.07
	Boys	61	$1.23 \pm 0.31$	1.81			
13	Girls	77	$1.43 \pm 0.46$	2.54	141	$1.32 \pm 0.41$	2.34
	Boys	64	$1.20 \pm 0.31$	1.81			
14	Girls	72	$1.39 \pm 0.50$	2.28	130	$1.3 \pm 0.45$	2.13
	Boys	58	$1.19 \pm 0.37$	1.89			
Total					408	$1.31 \pm 0.43$	2.16

**Table 3- Mean and 95% of random urine Potassium to creatinine ratio in children 12-14 years old**

Age Groups (years)	Sex	Number	Mean $\pm$ SD	95%	Total	Mean $\pm$ SD	95%
12	Girls	76	$0.31 \pm 0.11$	0.56	137	$0.31 \pm 0.1$	0.55
	Boys	61	$0.32 \pm 0.12$	0.55			
13	Girls	77	$0.31 \pm 0.11$	0.50	141	$0.29 \pm 0.10$	0.46
	Boys	64	$0.27 \pm 0.08$	0.41			
14	Girls	72	$0.28 \pm 0.10$	0.48	130	$0.28 \pm 0.10$	0.50
	Boys	58	$0.27 \pm 0.10$	0.50			
Total					408	$0.29 \pm 0.10$	0.52

## Discussion:

According to this study, the mean of urine Ca/Cr ratio in children from 12-14 years old was  $0.08 \pm 0.02$  and 95% of it was 0.13. The mean and 95% of U Ca/Cr ratio were  $0.04 \pm 0.04$  and 0.11 by Safarinejad et al.'s study in 11-14 years old children, respectively, [9]. So et al.'s reported that the mean of U Ca/Cr ratio in Caucasians children (7-16 years old) that was  $0.08 \pm 0.09$ . This ratio was  $0.04 \pm 0.04$  in African-American children with the same age [10]. In another study the 95% U Ca/Cr ratio in children 10-15 years old was 0.26 [14].

There are different values of morning U Ca/Cr ratio according to different areas. So, it is necessary to determine of this value according to geographic areas. The importance of geographic areas and their effects on U Ca/Cr ratio was reported by some authors. Crean et al.'s showed the effect of geographic areas on random U Ca/Cr [15]. Also, Hilgenfeld et al.'s reported the influence of season on normal U Ca/Cr ratio in children between 5.1-14.6 years old. Maximum and minimum mean U Ca/Cr was 0.09 and 0.08 in summer and winter, respectively. Of course, all values were in normal ranges [16].

The effect of age on random morning U Ca/Cr was reported by many authors [9, 10, 14-16]. In our previous report, the mean and 95% of U Ca/Cr were  $0.15 \pm 0.09$  and 0.36, respectively, in children between 7-11 years old [8]. Although there were some reports that shown U Ca/Cr wasn't influenced by age [11, 17, 18]. In So et al.'s study, there weren't any relationship between U Ca/Cr and age, sex, diet, physical activity, positive familial history of urolithiasis, amount of calcium in drinking water and symptoms related to hypercalciuria [10]. But Fallahzadeh et al.'s reported high U Ca/Cr in children 3-14 years old with urinary tract symptoms such as dysuria, urinary tract infection, urgency, abdominal pain, diurnal incontinency or enuresis [19].

Badeli et al.'s reported high U Ca/Cr in children with urinary tract infection and vesicoureteral reflux [20]. In this study there was no significant difference of U Ca/Cr in 12-14 years old. Also, same as some reports, U Ca/Cr ratio was not differ between boys and girls [9, 11, 13, 15, 18].

Although Alconcher et al.'s reported that in children from 6-13 years old, U Ca/Cr of boys was more than that of girls [21]. Therefore other studies may be needed for the effect of sex, age and other factors on U Ca/Cr ratio.

In this study, there was significant relationship between U Ca/Cr with Na/Cr and K/Cr ( $p < 0.05$ ) in

normal ranges. In So et al.'s study, there was a weak relationship between U Ca/Cr and Na/Cr ratio [10]. In some studies, there was correlation between U Ca/Cr and Na/Cr [14, 18, 22]. The risk of urinary complication is more in children with hypercalciuria. So, the effect of high U Na/Cr in normal U Ca/Cr range dose not clear and more studies may be needed.

In conclusion, 95% of U Ca/Cr in children who were 12-14 years old was 0.13 and there was no significant difference in boys and girls and more studies were needed to determine the age and renal loss of sodium and potassium on urine calcium excretion.

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**Conflict of interest:** There was no conflict of interest.

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