

Prevalence of Hypercalciuria among School Children

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Objective: To determine the prevalence of hypercalciuria in primary and secondary school students.

Design: Prospective randomized study.

Setting: Primary and secondary schools in Makkah and Baha, Saudi Arabia.

Method: Seven hundred ninety-six school-age children were included in a study from January 2007 to December 2007. Non-fasting random urine specimens were analyzed for calcium and creatinine concentrations.

Result: The mean ratio of urine calcium-creatinine (Ca/Cr) was 0.11; the range was 0.008 to 0.837. Non-fasting Ca/Cr ratios were significantly different between Makkah and Baha and between males and females in both cities. The Ca/Cr ratio was highest in 6-7 years-old students (mean, 0.14 ± 0.01). Seventy-eight (9.8%) students were hypercalciuric, 29 (3.6%) were from Makkah and 49 (6.2%) from Baha students. The prevalence of hypercalciuria differed with age.

Conclusion: The study showed highly significant difference in prevalence of hypercalciuria between Makkah and Baha. A child's geographic area, age and ethnicity should be taken into consideration when assessing the urinary calcium creatinine ratios.

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Idiopathic hypercalciuria is a common disorder in children and could present as hematuria, voiding dysfunction, flank pain, abdominal pain, nephrolithiasis, urinary tract infection, and decreased bone mineral density¹. Calcium excretion more than 4 mg/kg measured in 24-hour urine has been defined as hypercalciuria^{2,3}. It is difficult to take the accurate 24-hour urine in young children; therefore, hypercalciuria can be screened by random urine calcium-creatinine ratio (Ca/Cr)^{4,5}. A random urine Ca/Cr is of practical use in screening for hypercalciuria.

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However, due to worldwide variations, reference values for the pediatric population are not yet well established. Many authors have reported that urine Ca/Cr and hypercalciuria varies with geographic areas, age, diet habit, and genetic. It is well-established that Ca/Cr is low in Japan (0.6) and high in Aral Sea region^{6,7}. Similar studies in Iran showed different results, ranged from 0.11 in Urmia to 0.53 in Kashan^{8,9}.

The aim of this study is to assess the prevalence hypercalciuria in school students aged 6 to 15 years old.

METHOD

Seven hundred and ninety-six students were selected by stratified clustered random sampling from primary and middle schools during 2007. Documented data were age, gender, height, weight, urine level of calcium and creatinine and blood pressure. Children with conditions that would influence urinary calcium excretion such as being on medical treatment or suffering from chronic kidney disease were excluded. The children's height was measured in the standing position and their weight was measured with the least clothing. Blood pressure was measured from right arm in the sitting position. Early morning non-fasting urine sample was used to determine calcium and creatinine levels. Urine sample was analyzed by Cobas Integra (Cobas Integra, Germany). This test is based on the calcium creatinine ratio of 0.2, which is higher than what it was considered suggestive of hypercalciuria¹⁰. Complete urinalysis was done for detection of hematuria, proteinuria and glucosuria.

Data entry and analysis were done using SPSS, Version 19.

RESULT

Seven hundred and ninety-six students were included in the study. The age range was from 6 to 15 years and the average was 9.39 ± 0.07 years. The weight average was 30.66 ± 0.42 kg, ranging from 12 to 97 kg. The height average was 131, ranging from 106 to 170 cm. Blood pressure was measured with systolic average 114.57 ± 0.54 mmHg, ranging from (80-190 mmHg) and diastolic average was 75.53 ± 0.36 mmHg, ranging from (40-116 mmHg), see table 1.

Table 1: Shows the Sample Characteristics

		Overall	Mekkah		Baha		P Value
			Boys	Girls	Boys	Girls	
Distribution	Total	796	298 (37.4%)	98 (12.3%)	300 (37.6%)	100 (12.5%)	0.870
		0.1 – 1.15	396 (49.7%)		400 (50.25%)		
Age (years)	Mean \pm SE	9.39 ± 0.07	9.37 ± 0.10	9.68 ± 0.17	9.87 ± 0.11	7.69 ± 0.17	0.375
	Range	6 – 15	6 – 15	6 – 14	6 – 13	6 – 12	
Weight (Kg)	Mean \pm SE	30.66 ± 0.42	34.40 ± 0.18	30.43 ± 1.02	29.76 ± 0.57	22.43 ± 0.45	0.000
	Range	12 – 97	12 – 97	17.6 – 66.5	13 – 68.5	15 – 37	
Height (Cm)	Mean \pm SE	131 ± 0.00	132 ± 0.01	132 ± 0.01	133 ± 0.01	122 ± 0.01	0.081
	Range	106 – 170	107 – 169	112 – 157	106 – 170	108 – 143	
Blood Pressure	Mean \pm SE	114.57 ± 0.54	119.98 ± 1.02	121.79 ± 0.32	109.85 ± 0.46	105.53 ± 1.56	0.000

Systolic (mmHg)	Range	80 – 190	91 – 180	101 – 162	90 – 130	80 – 190	
Diastolic (mmHg)	Mean ± SE	75.53 ± 0.36	75.35 ± 0.69	79.03 ± 0.05	71.12 ± 0.39	69.95 ± 0.90	0.000
	Range	40 – 116	40 – 100	60 – 116	55 – 85	50 – 90	

Urine Analysis

Specific gravity and urine PH did not show any significant difference between Makkah and Baha students. Eighty-eight (11%) samples from Makkah and 5 (0.6%) from Baha were positive for leucocyte test and Ketone test were positive in 19 (2.4%) samples of Makkah and 2 (0.3%) of Baha. Bilirubin test was positive in 58 (7.3%) samples of Makkah and 2 (0.3%) of Baha. Hematuria was seen in 116 (14.6%) samples of Makkah and 82 (10.3%) in Baha. Nitrite test was positive in 13 (1.6%) samples of Makkah and 5 (0.6%) in Baha, see table 2.

Table 2: Urine Analysis

		Overall	Makkah		Baha	
			Boys	Girls	Boys	Girls
Specific Gravity	Mean ± SE	1.02 ± 0.00	1.02 ± 0.00	1.02 ± 0.00	1.02 ± 0.00	1.01 ± 0.01
	Range	0.1 – 1.15	1 – 1.15	1 – 1.025	1 – 1.03	0.1 – 1.03
PH	Mean ± SE	5.52 ± 0.03	5.54 ± 0.05	5.45 ± 0.07	5.48 ± 0.05	5.65 ± 0.07
	Range	5 – 9	5 – 9	5 - 8	5 - 9	5 – 8
Leucocyte	Negative	703 (88.3%)	223 (74.8%)	85 (86.7%)	299 (99.7%)	96 (96%)
	Positive	93 (11.7%)	75 (25.2%)	13 (13.3%)	1 (0.3%)	4 (4%)
Nitrite	Negative	778 (97.7%)	286 (96%)	97 (99%)	299 (99.7%)	96 (96%)
	Positive	18 (2.3%)	12 (4%)	1 (1%)	1 (0.3%)	4 (4%)
Ketone	Negative	775 (97.4%)	283 (95%)	94 (95.9%)	298 (99.3%)	100 (100%)
	Positive	21 (2.6%)	15 (5%)	4 (4.1%)	2 (0.7%)	0 (0%)
Urobilinogen	Negative	794 (99.7%)	296 (99.3%)	98 (100%)	300 (100%)	100 (100%)
	Positive	2 (0.3%)	2 (0.7%)	0 (0%)	0 (0%)	0 (0%)
Bilirubin	Negative	736 (92.5%)	244 (81.9%)	94 (95.9%)	298 (99.3%)	100 (100%)
	Positive	60 (7.5%)	54 (18.1%)	4 (4.1%)	2 (0.7%)	0 (0%)
Hematuria	Negative	598 (75.1%)	207 (69.5%)	73 (74.5%)	229 (76.3%)	89 (89%)
	Positive	198 (24.9%)	91 (30.5%)	25 (25.5%)	71 (23.7%)	11 (11%)
Glucosuria	Negative	794 (99.7%)	297 (99.7%)	97 (99%)	300 (100%)	100 (100%)
	Positive	2 (0.3%)	1 (0.3%)	1 (1%)	0 (0%)	0 (0%)
Proteinuria	Negative	498 (62.6%)	56 (18.8%)	51 (52%)	292 (97.3%)	99 (99%)
	Positive	298 (37.4%)	242 (81.2%)	47 (48%)	8 (2.7%)	1 (1%)

There was no significance difference between Makkah and Baha in Glucosuria and urobilinogen. Two (0.3%) were positive in Makkah and nobody was positive in Baha.

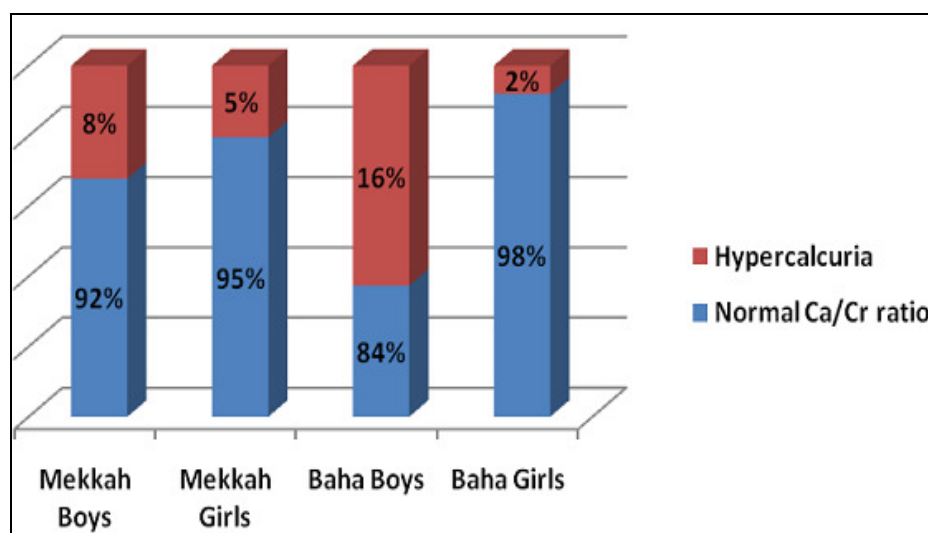
The mean urine Ca/Cr was 0.11 (range, 0.0082 to 0.837). The mean ratio showed a very highly significant difference between Makkah and Baha and between males and females in both cities, see table 3.

Table 3: Calcium/Creatinine Ratio

Ca/Cr ratio	Mean \pm SE Range	Overall	Makkah		Baha	
			Boys	Girls	Boys	Girls
		1.11 \pm 0.00	0.09 \pm 0.00	0.09 \pm 0.01	0.13 \pm 0.00	0.13 \pm 0.00
		0.0082 – 0.837	0.01 – 0.37	0.0082 – 0.837	0.025 – 0.225	0.0575 – 0.22

Based on the reference value, urine Ca/Cr of > 0.2 for diagnosis of hypercalciuria, 78 (9.8%) of the students in Makkah and Baha had hypercalciuria. Twenty-nine (3.6%) were hypercalciuric in Makkah and 49 (6.2%) in Baha. There was a highly significant hypercalciuria between males and females of Makkah and males and females of Baha.

The children were grouped into 5 groups according to age. Analysis of variance showed a relation between age and urine Ca/Cr. The mean values for urine Ca/Cr decreased by age except in the 10-11 years-old group, see Table 4. In 6-7 years-old group (n=12) the rate was 1.50%, see figure 1.

**Figure 1: Prevalence of Hypercalciuria between Boys and Girls****Table 4: The Prevalence of Hypercalciuria According to Age**

Year/Gender	Number	Total	Average	Range	Normal Ca/Cr ratio	Hypercalciuria
6 - 7	Male	70	0.14 \pm 0.01	0.0087 - 0.37	164 (20.6%)	12 (1.5%)
	Female	106				
8 - 9	Male	66	0.11 \pm 0.00	0.01 - 0.316	244 (30.6%)	1 (0.125%)
	Female	179				
10 - 11	Male	38	0.11 \pm 0.01	0.01 - 0.837	234 (29.3%)	4 (0.50%)
	Female	200				
12 - 13	Male	23	0.09 \pm 0.00	0.0082 - 0.21	135 (16.95%)	0 (0%)
	Female	112				
14 - 15	Male	1	0.14 \pm 0.01	0.045 - 0.06	2 (0.25%)	0 (0%)
	Female	1				

DISCUSSION

The reference value for urine Ca/Cr is 0.2, but many studies showed that reference values for urine Ca/Cr should be independently established for children in each country and also in each geographic region^{6,10-14}. Our results are similar to the results of Nikibakhsh study, in which the 95th percentile for urine Ca/Cr was 0.24, but less than the results from North West of Iran, which was reported to be 0.53^{8,9}. The 95th percentile for urine Ca/Cr values of the American children aged 7 to 14 years was 0.20¹⁵.

In children, urinary solute-creatinine ratio is a useful and reliable method for determining hypercalciuria; it is non-invasive and relatively inexpensive method. Based on our extracted threshold for urine Ca/Cr ratio, the prevalence of hypercalciuria was 9.8%. The reported prevalence of hypercalciuria differs from Makkah to Baha. In Japan, hypercalciuria was noted only in 0.6% of the children, based on urine Ca/Cr higher than 0.17 reference value. The mean urine Ca/Cr was significantly higher in Kazalinsk, Kazakhstan; hypercalciuria, was regarded as urine Ca/Cr higher than 0.703, which was seen in 38.6% of Kazalinsk children⁷. In north of Iran, the 95th percentile for urine Ca/Cr was higher than the reference value of 0.36¹⁶. Therefore, it is recommended to determine the reference value in every geographic area.

Urine Ca/Cr ratio usually changes with age. In the present study, the highest level was observed in children aged 6-7 years old. Previous studies showed a correlation between urine calcium excretion and age. Safarinejad showed that the highest ratio was between 6 months and 3 years, 0.047 ± 0.041 mg/mg⁵.

In Thailand, the 95th percentile for urine Ca/Cr in children younger than 6 months was 0.75¹². The 95th percentile for urine Ca/Cr of 0.25, in our study, is higher than the traditional normal urine Ca/Cr value of 0.21. Variations in urine Ca/Cr among different pediatric studies emphasize the role of geographic location. Extrinsic factors, such as nutritional habits, source of drinking water, season and climate, and exposure to sunlight might influence normal values of urine Ca/Cr. A child's age and ethnicity should be taken into consideration when assessing the urinary Ca/Cr ratios.

CONCLUSION

The study showed highly significant difference in prevalence of hypercalciuria between Makkah and Baha. A child's geographic area, age and ethnicity should be taken into consideration when assessing the urinary calcium creatinine ratios. It is recommended to determine the reference value in every geographic area.

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