

SHORT REPORT

Urinary calcium excretion in enterally fed disabled children

A K Shetty, J Carlin, M Z Mughal

Abstract

The urine calcium/creatinine (Ca/Cr) ratio was measured in 17 enterally tube fed disabled children. Urine Ca/Cr ratios were inversely related to dietary calcium intake in immobile children ($r = -0.57$, $p < 0.05$) but not in those who were able to stand or walk (mobile children) ($r = 0.4$, $p = 0.51$). None of the subjects had evidence of nephrocalcinosis or renal calculi detectable by renal ultrasonography.

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Keywords: hypercalciuria; mobility; enteral feeding

Genetic factors, weight bearing physical activity, and adequate dietary intake of minerals such as calcium are important for normal skeletal development. Children with disabilities are prone to atraumatic fractures associated with reduced bone mineral density,^{1 2} which in turn is associated with immobility and non-weight-bearing.² Recommended nutrient intakes (RNI) for calcium for mobility impaired disabled children have not been established. Furthermore, no data are available on the risks and benefits of increasing calcium intake in these children above current RNI for healthy children.³ We hypothesised that immobile children, who are enterally

tube fed on liquid feeds containing nutrients in fixed concentrations, might have an excessive calcium intake relative to their skeletal needs, which might lead to hypercalciuria, nephrocalcinosis, and renal calculi.

Methods

The study was approved by Manchester, Salford, and Trafford ethics committees. Written consent was obtained from parents; this was necessary even in older subjects, who because of their learning difficulties were not able to provide informed consent. Parents of 17 of 39 enterally tube fed disabled children aged 2 to 17 years (10 girls and seven boys), agreed to their children's participation in the study.

Disabilities in these children arose from a variety of conditions: genetic disorders, congenital vocal cord paralysis, intrauterine infection, perinatal asphyxia, meningitis, and undiagnosed conditions associated with global developmental delay.

Twelve children were classified as immobile (unable to stand) and five as mobile (able to stand or walk). Twelve children were entirely enterally tube fed and five were on a mixture of enteral tube feeding and "normal" diet. A standardised 3 day food diary was completed by parents and carers. The average daily intake of nutrients was estimated for each child from nutritional composition data provided by the manufacturers of the enteral feeds and using the Comp-Eat v.5 for Window Nutritional Software (CompEat Nutrition Systems, Closterworth, Grantham, UK). The second morning urine sample was collected on two occasions for each child, as Ghazali and Barratt have shown that this achieves the smallest degree of variation in the urine calcium/creatinine (Ca/Cr) ratio from 24 hour urine excretion values.⁴ The subjects were considered to be hypercalciuric if their average urine Ca/Cr ratio was > 0.74 .⁴

Urine samples were collected using Newcastle urine collection pads (Newcastle sterile urine collection packs, Ontex UK, Corby, UK). Previously, Ahmad *et al* had suggested that the use of urine collection pads was a reliable method of collecting urine from young children for culture and microscopy.⁵ We therefore performed a validation study on clean catch urine samples collected from 12 healthy adult volunteers aged between 21 to 57 years to confirm the reliability of this method for

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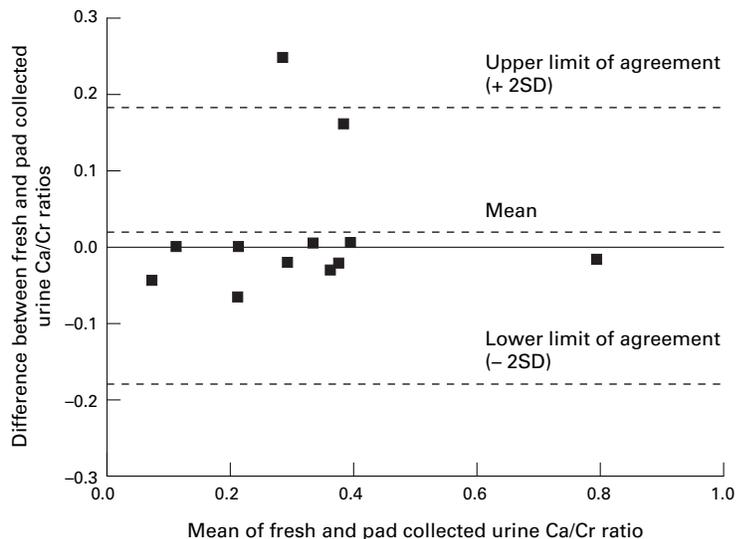


Figure 1 Bland-Altman plot showing the relation between the mean urine calcium/creatinine ratio (Ca/Cr) of freshly voided and pad recovered urine samples versus the difference between Ca/Cr collected and recovered by these methods, in 12 healthy adults.

estimating the urine Ca/Cr ratio. Each sample was divided into two portions and the Ca/Cr ratio was estimated in the freshly voided sample and a sample recovered from a Newcastle urine collection pad after a three hour soak. Figure 1, a Bland–Altman plot,⁶ shows that the differences between Ca/Cr values of fresh and pad recovered urine samples was independent of the average Ca/Cr values of the two collection methods; only one value was above the upper limit of agreement (> 2 SD).

An ultrasound scan of the renal tract was performed using a Toshiba Eccosee SSA 340A ultrasound scanner (Toshiba, Crawley, West Sussex, UK), to look for nephrocalcinosis and renal calculi. All scans were performed by the same radiologist (JC).

Results

Eight children were hypercalciuric (Ca/Cr > 0.74), and all but one of these were from the immobile group. Overall, the median Ca/Cr ratio was 0.72. The median Ca/Cr ratio in the immobile group was 0.83 (range 0.10 to 1.70) and that in the mobile group was 0.47 (0.29 to 0.92) ($p = 0.20$). A significant inverse relation was observed between dietary calcium intake (expressed as percentage of United Kingdom RNI³) and urine Ca/Cr ratio for all subjects ($r = -0.5$, $p < 0.05$). This was also true for the immobile group ($r = -0.57$, $p < 0.05$) but not for the mobile group ($r = 0.4$, $p = 0.51$) (fig 2). The median vitamin D intake of the immobile group was 7.2 $\mu\text{g}/\text{day}$ (range 3.4 to 18.5) and that of the mobile group, 9 $\mu\text{g}/\text{day}$ (3.4 to 18.5). No significant relations were observed between dietary vitamin D intake and the urine Ca/Cr ratio in the whole group ($r = -0.31$, $p = 0.23$) or in the mobile and immobile subgroups (immobile: $r = -0.43$, $p = 0.17$; mobile: $r = 0.4$, $p = 0.51$). None of the children was found to have nephrocalcinosis or renal calculi.

Discussion

The finding of an inverse relation between percentage RNI of calcium intake and urine Ca/Cr ratio in the immobile but not in the mobile group was contrary to our hypothesis that immobile children, who are enterally tube fed on liquid feeds, might have an excessive calcium intake relative to their skeletal needs. It is reassuring that neither nephrocalcinosis nor renal calculi were found in any of the subjects. However, hypercalciuria was found in nearly half of the children. This is a cause for concern as it may, with time, lead to nephrocalcinosis and renal calculi. From the results of this study, we speculate that inadequate calcium intake ($< \text{RNI}$) in immobile disabled children might cause secondary hyperparathyroidism, which in turn leads to increased urinary excretion of

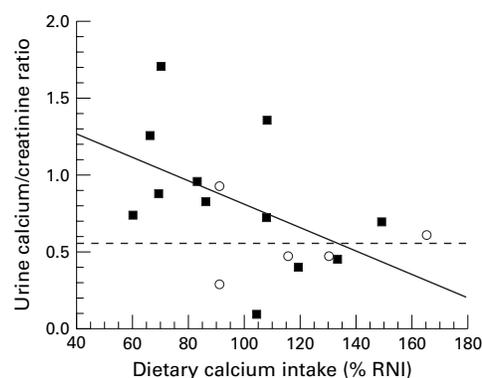


Figure 2 Relation between dietary calcium intake, expressed as percentage recommended nutrient intake (% RNI) for healthy children and urinary calcium/creatinine ratio. Children in the immobile group are represented by filled squares and a solid line ($r = -0.57$, $p < 0.05$) and those in the mobile group by empty circles and a dashed line ($r = 0.4$, $p = 0.51$).

calcium that is released into the circulation from skeletal stores.

Dietary intake of vitamin D was not significantly different in the mobile and immobile groups. According to the current Department of Health guidelines³ vitamin D supplements are not necessary for children older than 3 years. However, they may be important for immobile disabled children, as their opportunity for cutaneous vitamin D synthesis might be less than that of ambulant children.

Dietary calcium requirements of mobility impaired disabled children have not been assessed by balance studies or by stable isotope techniques. The results of our pilot study suggest that the current United Kingdom RNI³ for calcium for healthy children are probably adequate for immobile disabled children, as only those subjects with intakes of calcium $< \text{RNI}$ were hypercalciuric. Further studies are needed to clarify the optimal calcium and vitamin D requirements necessary for normal skeletal mineralisation while avoiding hypercalciuria in children with disabilities.

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