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Review

Calcium intake and serum calcium status in Mongolian children

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ABSTRACT

Dietary calcium intake in relation to calcium status in Mongolian children was investigated. This survey was a cross-sectional survey. A total of 835 children were randomly selected from 4 economic regions and Ulaanbaatar city. Information on dietary intake was collected from 835 children in the 1–3, 4–7, and 8–14 year old groups by a 24-h recall method. The average daily intake of calcium from diet was calculated for individuals. Blood samples were collected from 104 children.

The mean of daily calcium intakes as 273 ± 30.0 mg in 1–3-year old children, 309.0 ± 30.0 mg in 4–7 year old children, and 317.0 ± 31.0 mg in 8–14 year old children, respectively. There were statistically significant differences in calcium intakes between the age groups 1–3 years, 4–7 years, and 1–3 years, 8–14 years of children ($p < 0.001$).

Calcium intakes in all studied children of all age groups were lower (39%, 30.9%, and 24.4%) than the recommended level of calcium intakes.

In 22.1% of studied children, the serum total calcium concentration levels were below the normal range. Based on the total serum calcium, the prevalence of hypocalcemia was higher among children in the age group 8–14 years (27.6%) than the prevalence among children in the age group <1 year ($p < 0.05$).

Based on the corrected serum calcium values, the prevalence of hypocalcemia was higher (52.4%, 63.6%, and 51.1%) among children in the age groups 1–3, 4–7, and 8–14 years.

The mean level of corrected serum calcium were low (2.02 ± 0.04 , 2.05 ± 0.73 , and 1.99 ± 0.64 mg) in children in the age groups 1–3, 4–7, and 8–14 years. These findings suggest that low dietary calcium intakes may be reflected by hypocalcemia in Mongolian children. In conclusion, there is a need to improve a consumption of milk, dairy products in Mongolian children. In addition, there is need to use a vitamin D supplementation with a calcium supplementation in children with severe vitamin D deficiency rickets.

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1. Introduction

Calcium is a most important nutrient in the diet because it is a structural component of bones, teeth, and soft tissues and is essential in many of the body's metabolic processes. Thus, adequate dietary intakes of calcium are critical to normal growth and development of the skeleton and teeth as well as essential physiologic functions.

According to the daily recommended amount of calcium, a young child needs 700 mg of calcium every day between the ages of one and three years. His needs increase to 1,000 mg a day between four and eight years of age, and to 1,300 daily mg from 9 to 18 years [1].

Bone stores of calcium can be used to maintain adequate blood calcium levels. Short-term dietary deficiency of calcium generally does not result in significantly low blood calcium levels. But, over the long term, dietary deficiency eventually depletes bone stores, rendering the bones weak and prone to fracture [2]. A low blood calcium level is more often the result of a disturbance in the body's calcium regulating mechanisms, such as insufficient vitamin D [3].

The serum levels of calcium are regulated by the three major regulators; parathyroid hormone (PTH), the active form of vitamin D [1,25 (OH)₂D], and calcitonin [3,4].

Active transport of calcium is dependent on the action of 1,25-dihydroxyvitamin D, and its intestinal receptors [5,6]. This mechanism accounts for most of the absorption of calcium at low and moderate intake levels [8]. Passive diffusion becomes more important at high calcium intakes [8]. Also low levels of vitamin D lead to release of parathyroid hormone, which triggers calcium mobilization from the bone. The severe vitamin D deficiency rickets and low calcium intake were detected in Mongolian children under 5 of age and adolescents [9]. Thus, our goal in this cross-sectional survey was to investigate the influence of low calcium intake on the serum calcium status in Mongolian children.

2. Objective

Our objective in this cross-sectional survey was to investigate the influence of dietary calcium intakes on serum calcium level in Mongolian children.

3. Materials and methods

The 2008 cross-sectional Nutrition survey was conducted in 4 provinces of 4 economic regions of the country and the Ulaanbaatar capital city.

Information on dietary intake was collected from 835 children in the age groups 1–3 years, 4–7 years and 8–14 years using the 24-h recall method [2]. The average daily intake of calcium from diet was calculated for each individual [2]. Blood samples were collected from 104 children. Total serum calcium was measured using the photometric test. Serum albumin was measured using the photo colorimetric test.

Serum calcium and albumin measurement were done on the semi-automatic Humalyzer 2000. The corrected serum calcium was calculated for each measurement using the formula, corrected serum calcium = total serum calcium + [(40-serum albumin) × 0.02] [10–12]. The corrected serum calcium were calculated for each subject was used to categorise hypocalcemia (defined as a corrected serum calcium of <2.0 mmol/l) normocalcemia (a corrected serum calcium of 2.1–2.7 mmol/l) and hypercalcemia (corrected serum calcium of >2.7 mmol/l).

Table 1

Calcium intake from the diet compared with the AI recommendations by age group in Mongolian children.

Age group	Number of subjects	Daily calcium intake (mg)	Percent of AI recommendations
1–3	321	273.0 ± 30.0	39%
4–7	163	309.0 ± 30.0	30.9%
8–14	351	317 ± 31.0	24.4%
Total	835		

3.1. Data analysis

Statistical analysis was carried out using SPSS version 16.0 for Windows and INFO 2000 software [8]. Statistical significance was assigned for *P* values less than 0.05.

The corrected calcium calculator program was used for albumin-corrected calcium level.

3.2. Ethical considerations

The survey methodology was discussed by the Ethical Committee under the auspices of the Ministry of Health on 10 July, 2006 and was granted approval. Written and oral informed consent was obtained from the parents of the children who were randomly selected to participate in this survey.

4. Results

4.1. Calcium intake

The estimate of calcium intakes from the dietary histories in 835 children is tabulated in Table 1. Daily calcium intakes in all studied children of all age groups were lower (39%, 30.9%, and 24.4%) than the recommended level of calcium intakes. There were statistically significant differences in daily calcium intakes between the age groups 1–3 years, 4–7 years, and 1–3 years, 8–14 years of children (*p* < 0.001).

4.2. Uncorrected total serum calcium status

Based on the total serum calcium, the prevalence of hypocalcemia, normocalcemia and hypercalcemia were 22.1%, 75.0% and 2.9%, respectively (see Table 2).

Approximately 22.1% of study children has an insufficient nutritional status for long term, because hypocalcemia is uncommon in healthy children and adolescents, and the primary need for dietary calcium is to enhance bone mineral deposition, and to maintenance normal calcium balance. But over the long term dietary deficiency eventually depletes bone stores and failures blood calcium level.

Table 3 shows the prevalence of hypocalcemia, normocalcemia and hypercalcemia in children by age groups. The result shows that the prevalence of hypocalcemia was higher among children in the age group 8–14 years compared to children in the age group <1 year (*p* < 0.05). This can be related to the gap between the recommended calcium intakes and the typical intakes of dietary calcium in children in the age group 8–14 (see Table 1).

Table 2

Uncorrected total plasma calcium status.

Classification	No. of subjects	Percent
Hypocalcemia (≤2.0 mmol/l)	23	22.1%
Normocalcemia (2.1–2.7 mmol/l)	78	75.0%
Hypercalcemia (>2.7 mmol/l)	3	2.9%

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