KASHIN-BECK DISEASE: EVALUATION OF MINERAL INTAKE IN YOUNG TIBETAN CHILDREN FROM ENDEMIC AREAS

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Objectives

The main objective of this work was to measure the mineral content of most consumed Tibetan foods and to compare it to international reference tables. Highlight excess or deficiency among young Tibetan children from endemic areas was a secondary objective. 24-hour food recalls were collected by the means of prospective nutritional questionnaire. Mineral daily intakes were evaluated combining foods mineral contents and 24-hour food recalls.

Introduction

Kashin-Beck Disease

Kashin-Beck disease (KBD) is an endemic and chronic osteochondropathy characterized by short stature and skeletal deformities especially in long bones and joints. Joints become enlarged, stiff and painful. Mobility of limbs become limited and muscles can be atrophied. Peoples suffering from KBD get tired quickly and are weaker. Symptoms appear during childhood (3-5 years) and get progressively worse. This disease principally occurs in the Tibetan Autonomous Region and in several provinces of the People's Republic of China.

Many studies have already been conducted and many others are still underway, its etiology remains unknown. A multifactorial hypothesis has been proposed:

- selenium deficiency;
- high concentration of organic matters in drinking water (fulvic acids);
- mycotoxins poisoning by fungi infecting cereals.

Minerals and bone metabolism

Dozens of mineral elements directly or indirectly step in cartilage and bone metabolisms [chondrogenesis, bone osteogenesis, bone growth and bone homeostasis]. Recommended dietary intakes depend on several factors such as metabolic needs, life stage group and bioavailability.

Table 1. Recommended Dietary Intakes (RDIs) and Adequate Intakes (AIs) for the concerned life stage groups have been evaluated in the present study. Based from the Institute of Medicine of the National Academics.

Nutritional survey and foods sampling was done twice: January and May

24-hour food recalls of the 9-5 years old children by the mean of a prospective questionnaire.

Table 2. Measured dietary intakes involved in bone metabolism, their main functions and adverse effects of deficiency or excessive consumption.

Table 3. Important dietary intakes involved in bone metabolism, their main functions and adverse effects of deficiency or excessive consumption.

Materials and methods

Tibet Autonomous Region

10 families were selected in two regions according to three criteria:

- Living in endemic areas
- Having an older KBD child
- Perishable foods have been dried in the laboratory of the Tibet Center for Disease Control and Prevention.

Nutritional Survey

Foods sampling

Foods process

Belgium

Foods mineralization

Minerals measurement

Mineralized solutions were measured by several methods:

- Atomic absorption spectrometry (AAS, ETAAS, HG-AAS and ICP-AAS)
- Atomic emission spectrometry (ICP-AES)
- Molecular absorption spectrometry (UV-Vis)

Foods mineral contents

Evaluation of daily intakes

Comparison with reference tables

Results and discussion

Foods mineral contents

Analytical methods were successfully validated through CRM treated in the same procedure as samples. Foods mineral contents were expressed in mg/100g of fresh matter (FM) and compared with two reference tables: USDA National Nutrient Database and Souci Fischmann Kreut Food composition tables 1989/90.

Selenium content was too low to be quantified by both methods: HG-AAS and ICP-AES.

The results are as follows:

- Iron content is markedly high in barley flour and black tea. It is also clearly higher than referenced values in wheat flour, potato and butter;
- Selenium content is clearly lower than referenced values in barley flour, wheat flour, rice and Chinese cabbage;
- Black tea (leaves) is rich in several elements (Ca, Fe and Mn). Nevertheless, brewed black tea is drunk so much diluted that mineral supply is really low.

Nutritional survey

Daily intakes were estimated combining mineral measurements and nutritional survey results. They were computed via the Kidmenu® software. This software already included Tibetan diet recipes from a previous study of Souci Fischmann Kreut. In order to get an approximation of Se intake, LOD and UOD adapted values were encoded. The results are as follows:

- Tibetan’s diet is basically composed on cereal products.
- Fruits, nuts and dairy products are low consumed.
- Brewed black tea and butter tea are the most common beverages.
- Chong, a local made alcohol, is also largely consumed.
- There is a low diversity of recipes.

Conclusions and perspectives

This work constitutes an original nutritional study in the Kashin-Beck ethology context. The nutritional survey confirmed a monotonous and unbalanced diet. Most of foods are highly rich in iron while selenium is clearly deficient. Serious deficiency and excess have been highlighted in young Tibetan children from endemic areas. Nevertheless, this work presents some limits and restrictions:

- Some unmeasured foods were not take into accounts in this study such as chang, meat or even water.
- They are likely to supply sizeable amounts of minerals though.

Even if executed in two different endemic regions, the observed tendencies cannot be extrapolated to every endemic area. A larger study over a longer term covering both endemic and non-endemic regions is required for definite conclusions to be reached.

Dietary reference intakes can vary with the type of diet and it is important to notice that DRI tables are established for a standard population with a quite balanced diet. Yet, Tibetans may not be compared to a standard population and they do not have a balanced diet at all. Bioavailability of elements largely influences DRIs. It notably depends on the chemical speciation, on the presence of antinutritional factors (e.g. chelating agents), on the type of diet and on the individual.

The bioavailability of minerals is a critical point that deserves further investigations.