PILOTE STUDY:
COMPARISON OF MINERAL INTAKE BETWEEN CHILDREN FROM ENDEMIC AND NON-ENDEMIC AREAS FOR KASHIN-BECK DISEASE IN TIBET AUTONOMOUS REGION

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Background

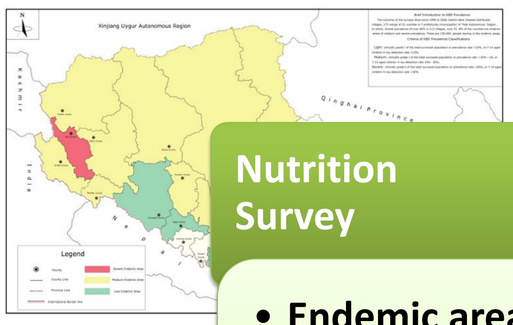
- **Kashin-Beck disease (KBD):** endemic and chronic osteochondropathy characterized by short stature and skeletal deformities especially in long bones and joints
- **Some figures:** between 0.74 million and 2.5 million people affected in the Tibet Autonomous Region and in several provinces of the People's Republic of China; between 10 and 30 million people living at risk in endemic areas.
- **Etiology:** unclear, although a multifactorial hypothesis has been proposed (selenium/iodine deficiency; high concentration of organic matters in drinking water; and mycotoxin poisoning by fungi infecting cereals)
- **Rationale for this study:** the rural population is almost exclusively affected. The diet of rural communities is very monotonous and poorly diversified, hence the likelihood of deficiencies and excesses.

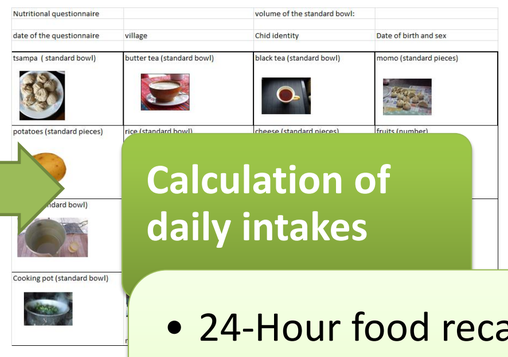
Objectives

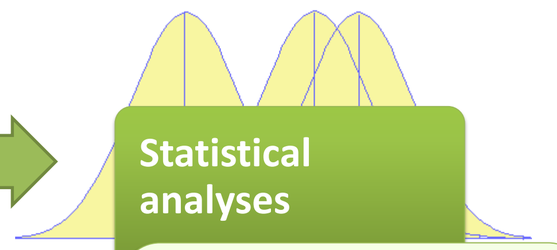
- Assessment and comparison of the mineral daily intake between Tibetan preschool children living in endemic areas for the Kashin-Beck disease and Tibetan preschool children living in non-endemic areas.
- Comparison of children daily intakes with Chinese Dietary Reference Intakes (DRIs)
- To estimate a sample size for a cross-sectional survey aiming to highlight significant differences in mineral intakes between the two groups of preschool children.

Materials and methods

KBD prevalence map of TAR







Nutrition Survey

- **Endemic area**:
  - 10 children
  - 2 campaigns
- **Non-endemic area:**
  - 10 children
  - 1 campaign

Calculation of daily intakes

- 24-Hour food recall
- Food sampling /chemical analysis
- Food composition tables

Statistical analyses

- Comparison of daily intakes between groups
- Estimation of sample size for a cross-sectional survey

Results and discussion

- **Remarks on the methodological approach**
  - the number of children enrolled, 10 per group, is weak → no prior information upon which to base the sample size, empirically decided for the sake of feasibility.
  - 24-hour recalls between the two groups are spaced in time → the diet of rural Tibetans is far from diversified, variability among seasons and years is probably low.
- **Assessment of daily intakes and statistical analyses**
  - Daily intakes calculated for **Ca, P, Mg, Fe, Zn, Cu and Mn**
  - Compared by One-way ANOVA's, factors: EAw (Endemic Area winter, February 2010), EAs (Endemic Area spring, May 2010), NEA (Non-Endemic Area, July 2011).
  - ✓ Significant difference for **Cu** (p-value<0.01); mean daily intake of 2001 µg/day for NEA, 1305 and 1299 µg/day for EAw and EAs respectively.
  - ✓ Mean **Fe** daily intake of NEA also significantly higher (p-value<0.05) than EAw (7.10 and 4.98 mg/day respectively), no significant difference with EAs (5.65 mg/day).
  - ✓ About Ca, P, Mg, Zn and Mn, no significant difference was detected.
- **Comparison of children individual daily intakes with Chinese Dietary Reference Intakes (DRIs)**
  - Manganese recommended values missing in Chinese DRIs, they were borrowed from the Food and Nutrition Board, Institute of Medicine, National Academies.
  - ✓ **Results** are summarized in **table 1**.
  - ✓ **Calcium**: Nine children on ten are below 100%, and even 50% of the recommended nutrient intake, suggesting a severe and general deficiency among rural preschool children. Partly explained by the diet of rural areas, low in dairy products.
  - ✓ **Manganese**: great excess are observed, 100% of children exceed ULs, some even reach six times the ULs !
  - ✓ **Zinc**: intakes below 100% DRIs for 8 to 10 children on 10 per group, though Zn deficiencies are smaller than for Ca.
  - ✓ **Bioavailability** of minerals is an important factor for nutritional recommendations. Ca and Zn deficiencies may be worsened due to the cereal-based rural diet, rich in **antinutritional factors** such as fibers and phytic acids. Oppositely, black tea, consumed much, is an important source of highly available Mn.
- **Estimation of sample size for a cross-sectional survey**
  - **Purpose:** being able to detect a significant difference in mineral intake of Ca, P, Mg, Fe, Zn, Cu and Mn between Tibetan preschool children living in endemic areas and in non-endemic areas.
  - ✓ A common power (1-β) for such study is 80%. In this case, the maximum sample size are too high and not feasible in practice, as seen in **table 2**.
  - ✓ Oppositely, the power was calculated per mineral, based on **100 children per group** table 3). It is **higher than 90%** for **Mg**, **Fe**, and **Cu**, for which significant differences were highlighted (except Mg). For the others minerals, the power is well below 80%. Nevertheless, general deficiencies and excesses have been observed in the two groups for part of these minerals, and intakes of the rest were normal . We believe that it is a statement in itself and trying to highlight small differences between groups in such extremes is not relevant.

Table 1. Number of children per area having daily intake below 100% Chinese DRIs and above Chinese Upper Levels

Mineral	Ca		P		Mg		Fe		Zn		Cu		Mn	
Area	<100%	>ULs	<100%	>ULs	<100%	>ULs	<100%	>ULs	<100%	>ULs	<100%	>ULs	<100%	>ULs
EAw /10	9	0	1	0	1	7	1	4	10	0	2	0	0	10
EAs /10	9	0	1	0	2	5	2	7	8	0	3	0	0	10
NEA /10	9	0	0	0	0	8	0	9	8	0	1	4	0	10

Dietary Reference Intakes and Upper Levels are coming from the China Food Composition tables. Values for Mn are missing and hence borrowed from the Food and Nutrition Board, Institute of Medicine, National Academies

Table 2. Calculated sample size (n), per group, $\alpha = 0.05$, $\beta = 0.2$ (based on the pilot study results; without insurance factor of 10%)

	Ca	P	Mg	Fe	Zn	Cu	Mn
EAs/NEA:	717,2	262,8	68,0	21,2	175,4	11,0	346,7
EAw/NEA:	4953,2	37,1	36,1	10,7	12,3	8,6	2740,6

EAs: endemic area spring; EAw: endemic area winter; NEA: non endemic area