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Fluoride, calcium and magnesium intake in children living in a high-fluoride area in Ethiopia. Intake through food

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Summary. *Objective.* The aim of this study was to assess the daily dietary fluoride intake in children living in two neighbouring villages in the Wonji Shoa Sugar Estate, a rural part of the Ethiopian Rift Valley.

Methods. The villages depended on water from different sources: Village A used either river water (Awash River, with 1·8 mg F^-/L) or ground water (2·1 mg F^-/L), while village K was served ground water with 14 mg F^-/L. Fifteen fully weaned children below the age of 5 years were selected in each of the villages. Over a four-day period the total food intake for these children was assessed by using a duplicate portion technique. The food was analysed for fluoride by using a fluoride ion-selective electrode after the dry ashing. Furthermore, the energy of the food was measured, as well as the calcium and magnesium contents (atomic absorption spectrometry after microwave digestion with nitric acid and hydrogen peroxide). The mothers gave a description of the ingredients used for preparing the food. Relevant background information concerning food habits, etc. was collected through a food frequency questionnaire.

Results. This study shows that considerable amounts of fluoride may be retained in food prepared on high-fluoride water. In village A, food contributed 2·3 mg F^-/day, while a dietary fluoride intake of 4·8 mg/day was found in children in village K. Interestingly, the sevenfold higher fluoride concentration of the water used for food preparation in village K compared to village A, gave only a doubling in fluoride intake through food. Calcium intake was relatively low while magnesium intake was above the recommended level.

Conclusion. As the energy intake by both groups was low, some systematic underreporting might be suspected. Thus, the fluoride intake in the group may be even higher than what was actually found in this study.

Introduction

In general, drinking water, beverages, toothpaste and other caries preventive agents are regarded as the main dietary contributors to human fluoride intake. Fluoride intake in infants and children younger than 2 years of age has been reported to be in the range 0·2–0·8 mg/day (water fluoride concentration 0·05–1·0 mg/L) [1–3]. Infants given formula milk often have a higher fluoride intake than breastfed children, the fluoride intake depending on the water fluoride concentration used for preparation [1,4].

Two to 5-year-old children living in areas with water fluoride concentrations below 1·2 mg/L, have a daily fluoride intake in the range of 0·2–1·0 mg. The intake, on a body weight basis, varies between 0·02

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and 0·07 mg/kg body weight (bw) [5–8]. The study areas included in the reports cited represent both naturally and artificially fluoridated water sources. Only a few studies have reported total fluoride intake in areas with water fluoride concentrations > 2 mg/L. In these areas the fluoride intake seems to be in the range of 3·5–14·5 mg/day [4,5,8].

Traditionally, human fluoride intake has been calculated based upon water intake and the fluoride concentration of the water used in the household. However, dental fluorosis may be found even in areas where drinking water contains presumably 'safe' amounts of fluoride [9]. In these cases, dietary risk factors such as tea and fluoride contaminated salts ('magadi') may account for a smaller or greater part of the fluoride intake [10–12].

Estimation of total dietary fluoride intake in individuals living in high-fluoride areas may be based either on analysis of *raw food ingredients* [13–17] or analysis of a selection of *prepared food dishes* [8,18]. The fluoride content of a dish depends on the fluoride content of the food ingredients, the fluoride concentration of the water, and the amount of water used and retained in the food during preparation.

Also the bioavailability has to be taken into consideration when discussing fluoride intake and health. The few reports published on this subject indicate great variation in availability, ranging from 2% (North Indian vegetarian diet) to 100%, e.g. for easily soluble sodium fluoride [19–23]. The mineral content of food, especially calcium and magnesium, may be of importance for the bioavailability of fluoride due to formation of insoluble complexes [24–27].

The aim of this study was to assess the daily dietary intake of fluoride, calcium and magnesium, in children living in two neighbouring villages with different water fluoride concentration. In order to assess the possibility of underreporting, the energy content of the collected food samples was determined.

Subjects, material and methods

Study area and population

The study was carried out over four consecutive days in November 1997 (from Sunday 17th to Wednesday 20th), at the Wonji Shoa Sugar Estate (WSSE). The WSSE is located in a rural area in the Ethiopian Rift Valley (110 km south-east of Addis Ababa), bordering the Awash River. Thirty families were selected from two factory villages, labelled A and K. The criterion for inclusion in the project was the presence of at least one child in the household, fully weaned and below the age of 5 years. Only one child per household was studied. When more than one child in a household was suitable for the study, we picked the eldest one for the first time, the youngest one for the second time, and so on.

The families who volunteered to participate in the survey were compensated with a sack of teff after the study period, which is the locally preferred staple food.

Social, demographic and environmental data

Wonji Shoa Sugar Estate is run by a state-owned company, the Wonji-Shoa Sugar Factory (WSSF). The estate contains two factory villages and 14 plantation villages. The total population is approximately 30,000. WSSF provides free residential facilities including housing, water supply and electricity, schools, and free medical service to its employees and their families.

All villages are provided with well water for domestic purposes. Due to elevated fluoride concentration in the drilled wells, defluoridation plants were installed between 1962 and 1976. For practical reasons, the plants are not in continuous function. At the time of the food survey, the pipeline supplying water to village A was broken, and the families collected drinking water from either Awash River (1·8 ± 0·3 mg/L; $n = 10$) or from a well in the factory town, Wonji (2·1 ± 0·1 mg/L; $n = 5$). In village K, the well water had a fluoride concentration of 14·4 ± 0·4 mg/L ($n = 15$) [28].

Food survey

A duplicate portion technique was used for the collection of food samples for element analysis, i.e. the mothers prepared a second portion of food and beverages, identical in content and volume to the portion taken by the child. Twenty-four-hour duplicate portions were collected over four consecutive days (Sunday through Wednesday), including one of the Orthodox Christians' fasting days. A native nurse from the local hospital instructed the mothers in the sampling procedure. On the first day of the survey, all families were visited to ensure correct sampling. Food samples (duplicate diets) for each 24-h period were stored in plastic containers and collected the following morning. The collected samples were weighed (precision of scale 0·1 g) at site, and brought to the local hospital for homogenization. Approximately 50 g of each homogenized sample was transferred to plastic containers, dried in an oven (50 °C) and thereafter kept in a refrigerator. After one week, the samples were transported to Norway for analysis in the Laboratory of Dental Research, University of Bergen, and National Institute of Nutrition and Seafood Research, Bergen.

The mothers gave a description of the ingredients used in preparing the food and provided relevant background information concerning food habits, etc. through a food frequency questionnaire.

Food description

The main staple in the study area was enjera made from teff. Enjera is an unleavened bread prepared by fermentation of teff, wheat, barley, maize or sorghum, or from a mixture of these [29]. Teff flour is prepared from the seeds of the grass *Eragrostis tef*. Teff seeds have high contents of calcium and iron, and are also rich in the sulphur containing amino acids cysteine and methionine [30].

Anthropometry

Standardized procedures were used to measure mid-upper arm circumference [31]. The children's weight was measured to the nearest 0·5 kg without shoes and jacket (with light clothes). The anthropometric measurements [Table 1] were conducted at the children's homes and the same person conducted the measurements throughout the study.

Analysis

The fluoride concentration was determined using a fluoride ion-selective electrode (9609) connected to an ion-meter (Orion 940A, Bergman AS, Lillestrom, Norway), according to a method described elsewhere [32]. A Certified Reference Material (Fluorine in Vegetation, SRM-2695, National Institute of Standards and Technology), was analysed together with the samples. The calcium and magnesium concentrations of the food samples were determined by the use of atomic absorption spectrometry after microwave digestion with nitric acid and hydrogen peroxide [33]. These methods are accredited by the Nordic Committee on Food Analysis. A Certified Reference Material (Bovine Liver, 1577b, National Institute of Standards and Technology), was analysed together with the samples. The moisture content of the food samples was determined by drying the samples to constant weight: first by drying for 24 h (50 °C) at the laboratory in Ethiopia, and thereafter to constant weight in Norway (105 °C). The total fat content of the food samples was determined gravimetrically after extraction with ethyl acetate [34]. The ash concentration of the foods was likewise determined gravimetrically by burning all organic substances in a programmable furnace where the temperature was gradually increased from ambient to 550 °C and held at 550 °C for 20 h. The protein concentration was determined by a microKjeldahl method whereby the nitrogen content is multiplied by 6·25 [35]. A certified reference material (Pork meat reference material, SMRI 94–1, Swedish National Food Administration, Uppsala, Sweden) was analysed together with the samples. Calculations of the metabolizable energy of carbohydrates, fat and protein were done by use of Atwaters factors for available energy –38 kJ/g for fat, and 17 kJ/g for protein and carbohydrate [36].

Statistics

Statistical calculations were performed by the use of Statistical Program for Social Sciences (SPSS).

Ethical considerations

Ethical approval for this study was obtained from Health and Public authorities (Oromia Region, Ethiopia). Informed consent was obtained from all participating families.

Table 1. Number, age, weight, mid-upper arm circumference (MUAC), and sex of children; village A and village K.

Village	*n*	Age Mean ± SD (months)	Age range (months)	Weight Mean ± SD (kg)	Weight 50th percentile	MUAC Mean ± SD (cm)	MUAC 50th percentile	Sex Female	Male
A	14	39·7 ± 11·8	24–60	13·3 ± 2·2	14·0	14·7 ± 1·1	14·5	7	7
K	14	40·8 ± 9·1	29–60	14·2 ± 2·0	13·5	15·3 ± 1·2	15·5	6	8

Results

One child from each of the villages was excluded from the survey: A child from village A had a very low energy intake (1·0 MJ), while a child from village K was severely undernourished (24 months old and body weight 7 kg).

The mean daily fluoride, calcium and magnesium intakes in children from village A and K are given in Table 2. Great individual variation was seen, while the mean day to day variation was small.

The duplicate diets sampled during the four days showed little variation in food ingredients. Food made from cereals was most commonly used. The locally grown teff was the only cereal used all four days by all 28 families. Approximately 40% (in grams) of the food sampled consisted of enjera, fried enjera pieces, or bread made from teff. The children ate little fruit or food of animal origin during the period of the food survey. The results from the food frequency questionnaire substantiate the lack of variation in food ingredients. Beef, fish and chicken were rarely used (once per month or less) by most of the families, whereas onion, teff and beans where reported to be consumed daily by most of the families. Twenty-three of the mothers answered that the season had little influence on the choice of food ingredients. The children were usually given the same food as the rest of the family, but with an extra meal during the day. All 14 children in village A were served four meals daily. In village K, 11 of the children got four meals a day, while two children were served three meals daily (one family did not answer).

The children had a mean energy intake of 2·6 ± 0·8 MJ. The individual variation was great, ranging from 1·5 to 5·6 MJ [Table 3]. When a diet contains moderately amounts of fibre, values for available energy calculated by use of Atwater factors should probably be reduced by about 5% [36]. Adjusting the energy calculation by 5% due to the high intake of vegetables [36], resulted in a mean energy intake of approximately 2·5 MJ. Of the energy-yielding components, approximately 80 energy percent (E%) was derived from carbohydrates. Protein and fat contributed with 14 E% and 6 E%, respectively.

The nutritional status of the children was assessed using anthropometric measurements. The mid-upper arm circumference [Table 1] indicates that the children as a group had a normal nutritional status.

Table 2. Mean concentration in food samples (mg/kg), mean daily dietary intake (4 days) of fluoride, calcium and magnesium, and recommended daily nutrient intake for the given elements (mg).

Element	Village	Wet weight (mg/kg)	Intake (mg)	RNI (mg)
Fluoride	A	5·4 ± 2·0	2·3 ± 0·7	1·4*
	K	10·6 ± 1·3	4·8 ± 1·5	
Calcium	A	580 ± 190	270 ± 130	500–550†
	K	830 ± 470	370 ± 220	
Magnesium	A	500 ± 80	250 ± 60	60–76†
	K	550 ± 50	240 ± 70	

*Tolerable upper intake level (mean weight 14 kg) (45).
†Recommended nutrient intake (RNI) (48).

Discussion

According to international standards, the water supply in Ethiopia is generally inadequate, especially in rural areas. Increasing population density, scarcity of drinking water and pollution of surface water pose a serious problem to drinking water supplies [37,38]. The Ten-Year Perspective Plan of the Water and Sanitation Subsector stated that the government was able to provide water to only 2·1 million out of the 38 million rural Ethiopians by 1983–84 [39]. In the Ethiopian Rift Valley high-fluoride drinking water is the rule rather than the exception, and fluorosis is endemic [40,41]. Analyses performed 10 years ago found fluoride concentrations ≥ 1·5 mg/L in 72% of 65 water locations. Seven of the water sources had fluoride concentrations between 20 and 177 mg/L [41]. Similarly, in a recent multielement analysis of 138 ground water sources in the Rift Valley, 60% of the wells provided water with ≥ 0·7 mg F^-/L, while 33% contained water with ≥ 1·5 mg F^-/L [37]. Considerable amounts of fluoride from water used for the preparation of food may,

Table 3. Composition of the food; mean daily intake values (wet weight) and SD. Minimum and maximum values are given in brackets.

Village	Food intake (g)	Moisture (%)	Protein (g)	Fat (g)	Ash (g)	Energy (MJ)
A	450 ± 110	68 ± 3	20 ± 5	4 ± 3	7 ± 2	2·4 ± 0·5
	(320–660)		(14–33)	(2–14)	(5–12)	(1·5–3·2)
K	450 ± 140	61 ± 6	24 ± 8	4 ± 2	7 ± 2	2·9 ± 0·9
	(290–750)		(14–44)	(2–6)	(5–13)	(1·9–5·6)

as shown in the present study, be retained in food. This is clearly demonstrated in the daily fluoride consumption in the two villages: In village A, where the fluoride concentration in water was approximately 2 mg/L, food contributed 2·3 mg F^-/day, while a dietary fluoride intake of 4·2 mg/day was found in children in village K, where water with 14 mg F^-/L was used for food preparation. It is interesting, however, that this 7-fold increase in fluoride concentration of the water used for food preparation gave only a doubling in fluoride intake through food. According to the information given by the mothers, the children consumed no typically high-fluoride food items, such as magadi. The fluoride content of the food therefore gives a good picture of the amount of fluoride retained from water during food preparation. We are presently unable to give a comprehensive explanation of the relatively high fluoride intake through food in village A. Some fluoride may, however, come through the ordinary food items. The fluoride content of teff flour from an area close to the study area (Awasa) has been analysed previously. Teff, which is the main ingredient in food consumed by the children in this survey, had a fluoride content of 6·7 (white) and 6·9 mg/kg dry weight (red) (moisture content: 11%) [17]. Except for tea, most vegetables grown in low-fluoride areas have a fluoride content less than 1 mg/kg [42–44].

The fluoride intake from beverages in the children studied has been reported previously [28], and was 1·3 ± 0·1 mg and 7·2 ± 1·5 mg in village A and K, respectively. Thus, most of the total daily fluoride intake in children living in village A is derived from food (63%), while children in high-fluoride village K get most of their fluoride through beverages (60%). The total fluoride intake (food and beverages) is approximately 3·6 mg and 11·4 mg in village A and K, respectively. It is important to keep in mind that some of the fluoride ingested through food in this survey comes from water used for food preparation.

Zohouri and Rugg-Gunn [8] found a total dietary fluoride intake of 0·4, 0·7 and 3·5 mg/day in 4 year old Iranian children living in areas with 0·3, 0·6 and 4·0 mg F^-/L, respectively, in the drinking water. Beverages were found to be the main fluoride source and contributed 72, 79 and 87% of the total fluoride intake. In a Kenyan study, Opinya *et al*. [4] found a total daily fluoride intake of 14·5 mg (range 6–24 mg) in children aged 1–4 years living in an area with 9 mg F^-/L in the drinking water. In both studies, tea consumption was found to contribute significantly to the total fluoride intake. Opinya *et al*. [4] reported that food, beverages other than tea, and tea, contributed almost the same to the total intake. If tea is excluded, the average total intake in the children was 9·5 mg F^-/day. Tea has been reported [4,8,43] as the single item contributing most to the dietary fluoride intake. The Ethiopian children in the present study consumed little tea [28], which might explain why beverages contributed relatively less to the total fluoride intake.

The high fluoride intake in the children studied in the present survey is worrying, especially when taking into consideration that the children's permanent teeth are still being formed. A tolerable upper intake level (UL) of 0·1 mg/kg body weight/day is established for infants, toddlers and children through 8 years of age [45]. According to this, the daily fluoride intake in the children should be less than 1·4 mg (mean weight of 14 kg). Thus, a fluoride intake of 4·2 mg/day – as seen in village K – is three times the UL.

While the absorption of fluoride from drinking water is almost complete, the bioavailability from food has been reported to vary between 2 and 79% [19,21]. Food by itself [22,23,46], and especially minerals like calcium [24,27] and magnesium [25,26], are known to interfere with the bioavailability of fluoride. Teff, which was found to be a main ingredient in the children's diet, is known to have a relatively high content of calcium [47]. The mean calcium intake by the children, was, however, low as compared to recommendations given by FAO/WHO [48], but above what can be considered to be the biological requirement (200 mg/day) [49]. As the diet of the children contained little milk, milk products and fish, teff and pulses were the main sources of calcium. A calcium intake close to the biological requirement is common in low-income countries [49]; furthermore, the bioavailability of calcium may be low in vegetable-based diets due to the chelation properties of phytates and oxalates.

The magnesium intake in the examined children studied was high. This is not surprising as vegetables are generally considered as good magnesium sources. In the present survey, even the children with the lowest magnesium intake were above the recommendations. Further studies are necessary to evaluate the effect of the high magnesium intake on fluoride absorption.

The daily intake of fat in the children is extremely low (2–14 g) as compared to recommendations (35–42 g) given by King and Burgess [50]. Also the median protein intake (21 g) is low as compared to recommendations (23–26 g) for a diet high in fibre and with little animal protein [50]. The energy derived from fat (6 E%) is far below the recommendations, but is consistent with what has previously been reported in children living in the Sidamo area (Ethiopia) [51]. The staple food in this region is false banana (*Ensete ventricosum*) which, as compared to teff, has a very low protein and fat content (Ågren *et al*. 1975; Gobezie *et al*. 1997). The low fat intake can explain the low energy intake. Fatty food ingredients are scarce and highly prized and may therefore not be part of the duplicate portion.

Conclusion

The results of this study show that high-fluoride water used in the preparation of food to Ethiopian children below the age of 5 contributed considerably to the total fluoride intake. A 7-fold increase in the fluoride concentration of water used for food preparation gave a doubling in fluoride intake through food. Food, as well as beverages, has to be considered when the total fluoride intake is assessed. Calcium intake was relatively low while magnesium intake was above the recommended level. More studies are necessary to evaluate the influence of a high magnesium intake on the bioavailability of fluoride. The energy intake in the children was low and indicates some degree of under-reporting. Thus, the real fluoride intake may be even higher than was found in this survey.

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Résumé. *Objectifs*. Cette étude a eu pour objectif d'évaluer la prise alimentaire journalière de fluor chez des enfants vivant dans deux villages voisins de l'état de Wonji Shoa Sugar, une zone rurale de la Rift Valley éthiopienne. Les villages dépendaient de différentes ressources en eau. Le village A utilisait l'eau de rivière (Awash River, avec 1,8 mg F^-/l) ou l'eau de puits (2,1 mg F^-/l), tandis que le village K utilisait l'eau de puits avec 14 mg F^-/l.
Méthodes. Quinze enfants totalement sevrés et âgés de moins de 5 ans ont été sélectionnés dans chaque village. L'alimentation totale de ces enfants a été évaluée, sur une période de 4 jours, par technique de portion dupliquée. Le fluor de la nourriture a été évalué à l'aide d'une électrode sélective pour ion fluor après combustion à sec. De plus, la composante énergétique a été mesurée, de même que le contenu en calcium et magnésium (spectrométrie d'absorption atomique après digestion par micro-ondes avec acide nitrique et peroxyde d'hydrogène). Les mères ont donné une description des ingrédients utilisés pour préparer la nourriture. Des renseignements complémentaires sur les habitudes alimentaires ou autres ont été collectés par questionnaire.
Résultats. Cette étude montre que des quantités considérables de fluor peuvent être retenues dans la nourriture préparée avec une eau fortement concentrée en fluor. Dans le village A, la nourriture apportait aux enfants 2,3 mg F^-/jour, contre 4,8 mg F^-/jour dans le village K. Il est intéressant de noter que la concentration en fluor 7 fois plus importante dans l'eau du village K n'a amené qu'une concentration 2 fois plus importante dans l'apport par la nourriture. La prise de calcium a été relativement basse tandis que celle de magnésium était au-dessus des valeurs recommandées. Comme la composante énergétique était faible dans les deux groupes, il est possible que la quantité rapportée ait été systématiquement sous-évaluée.
Conclusion. Le prise de fluor dans le groupe peut même avoir été supérieure à celle retrouvée dans cette étude.

Zusammenfassung. *Ziele*. Ziel dieser Studie war es, die tägliche Fluoridaufnahme bei Kindern in zwei benachbarten Gemeinden in Wonji Shoa Sugar Estate, einem ländliche Teil Äthiopiens, miteinander zu vergleichen. Die Trinkwasserversorgung war unterschiedlich für beide Gemeinden: gemeine A nutzte entweder Flusswasser (Awash River, 1.8 ppm Fluorid) oder Grundwasser (2.1 ppm Fluorid), während Gemeinde K versorgt war mit Grundwasser mit 14 ppm Fluorid.
Methoden. Fünfzehn gesunde Kinder unter fünf Jahre alt wurden in beiden Gemeinden ausgewählt. Über einen Zeitraum von vier Tagen wurde das Essen nach der doppelten-Portion-Technik analysiert mit einer fluoridsensitiven Elektrode nach Überführung in Asche. Außerdem wurde der Energiegehalt

gemessen, ebenso Calcium und Magnesiumgehalt (mit Atomabsorptionsspektroskopie nach Mikrowellenverdau mit Salpetersäure und Wasserstoffperoxid). Die Mütter lieferten Angaben zu Zutaten und Herstellung der Nahrung. Relevante Hintergrundinformation zu Ernährungsgewohnheiten und usw. wurden mit einem Fragebogen gesammelt.
Ergebnisse. Diese Studie zeigt, dass erhebliche Mengen an Fluorid enthalten sein können in Nahrungsmitteln, die mit fluoridhaltigem Wasser hergestellt wurden. Interessanterweise führte die siebenfach höhere Fluoridkonzentration in Gemeinde K nur zu einer doppelten Fluoridkonzentration in der Nahrung: In Gemeinde A wurden 2.3 ppm Fluorid in der Nahrung gefunden, in Gemeinde K 4.8 ppm. Calcium war insgesamt niedrigwährend Magnesion oberhalb der empfohlenen Dosierungen lag. Der Energiegehalt war in beiden Gemeinden niedrig, was auf systematisches Underreporting schließen lässt.
Schlussfolgerung. Die Fluoridexposition, die in dieser Studie gefunden wurde, könnte sogar noch überschritten werden.

Resumen. *Objetivos.* El objetivo de este estudio fue valorar la ingesta de flúor en la dieta diaria en niños que viven en dos pueblos vecinos en Wonji Shoa Sugar Estate, una zona rural del Valle del Rift de Etiopía. El agua de estos pueblos dependía de diferentes fuentes: El pueblo A usaba tanto agua del río (río Awash, con 1,8 mg F^-/l) o agua subterránea (2,1 mg F^-/l), mientras que el pueblo K se abastecía de agua subterránea con 14 mg F^-/l.
Métodos. Se seleccionaron, en cada pueblo, quince niños totalmente deshabituados a la lactancia menores de cinco años. Se valoró la ingesta total de comida de estos niños durante un período de cuatro días, mediante una técnica de porción duplicada. Se analizó el flúor en la comida mediante un electrodo de ion selectivo en ceniza seca. Además, se midió el valor energético de la comida, así como los contenidos de calcio y magnesio (espectometría de absorción atómica de microondas después de la digestión, con ácido nítrico y peróxido de hidrógeno). Las madres describieron los ingredientes usados para preparar la comida. La información relevante concerniente a los hábitos alimentarios etc. se recogió a través de un cuestionario de frecuencia de comidas.
Resultados. Este estudio muestra que se pueden retener cantidades considerables de flúor en la comida preparada con agua altamente fluorada. En el pueblo A la comida contribuyó con 2,3 mg F^-/día, mientras que en los niños del pueblo K la ingesta de flúor en la dieta fue de 4,8 mg/día. Es de destacar la concentración de flúor siete veces más alta en el agua utilizada en la preparación de la comida en el pueblo K comparada con la del pueblo A, que dio sólo el doble en la ingesta de flúor a través de la comida. La ingesta de calcio fue relativanente baja, mientras que la magnesio estuvo por encima del nivel recomendado. Como la ingesta energética fue baja para ambos grupos, se puede sospechar alguna falta de información sistemática.
Conclusión. Así pues, la ingesta de flúor en el grupo puede ser incluso más alta de lo que realmente se encontró en este estudio.

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