

## NUTRITION SURVEY IN DENTAL FLUOROSIS-AFFLICTED AREAS

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**SUMMARY:** The fluoride (F) intake, diet, and health status of children in two dental fluorosis-afflicted areas in the Province of Jiangxi, China were studied in an attempt to correlate nutritional status with dental fluorosis. The relationship between milk consumption and the incidence of dental fluorosis among the children was stressed in this study. Average body weight of the children approximated that of the national standard. Protein intake was above the national standard of 0.75 g/kg body weight/day, but the protein was derived mainly from plant sources. Calcium intake was found to be insufficient. Based on the diet and fluoride intake of the studied groups, the areas with a better nutritional status were found to have a lower incidence of dental fluorosis. The incidence among milk-consuming children was lower than that of non-milk-consuming children.

**Key words:** Calcium; Dental fluorosis; Milk consumption; Nutrition survey.

### INTRODUCTION

Several fluorosis-afflicted areas exist in Pingxiang District within the province of Jiangxi, China. Overall incidence rate of dental fluorosis in the district was reported to be above 50%.<sup>1,2</sup> Fluoride content of drinking water has been analyzed for every village in the region, and the average is lower than 0.3 mg/L. Although the daily fluoride (F) intake by the residents in the disease area was higher than that in non-disease (reference) area, it was no more than 3.5 mg/person.<sup>3</sup> Except for exposure to high levels of environmental F (air pollution, mainly from coal-burning in residents' homes, affecting food),<sup>1-4</sup> little is known about other factors contributing to the high incidence of dental fluorosis among the residents. In this study we carried out a nutrition survey of residents in two villages within the district, in an attempt to correlate nutritional status of the residents with the incidence rate of dental fluorosis.

### MATERIALS AND METHODS

**Study areas:** Two villages whose dental fluorosis incidence rate was similar to each other but whose economic conditions markedly differ from each other were selected for this study. One of the villages, located in a suburban area with a higher living standard, had 30% incidence of dental fluorosis. The other village, located in a rural area with poor economic conditions, had 34% incidence of dental fluorosis.

**Fluoride intake:** Fluoride intake was assessed by analyses of fluoride levels in the air, water, and several kinds of foods including rice, and vegetables.

**Nutrient intake:** Using questionnaires, the annual food consumption by 150 households in each village was studied. Based on food composition tables, daily dietary intake by the adult residents were calculated.

**Health examination:** 120 male residents and an equal number of female residents, aged 40-50, were selected from each village for health examination. The residents had been living in the district all their lives and were free from

chronic diseases except for dental fluorosis. Physical examination and biochemical tests, including blood and urine tests, were performed.

**Dental fluorosis among children:** A dental fluorosis survey among school children, both boys and girls, age 8-14, was carried out using questionnaires and a follow-up study in several schools. The children were divided into groups based on whether or not they consumed milk from four years of age. Incidence of dental fluorosis in the two groups was studied based on Dean's classification.

## RESULTS

Total fluoride intake by residents living in the suburban area was more than 20% higher than that in the rural area, and more than 90% of the total F intake was derived from consumed food (Table 1).

TABLE 1. Daily fluoride intake

Area	Total fluoride intake (mg/day/person) X ± SD	Percent of total intake		
		Water	Food	Air
Suburban	3.20 ± 0.07	5.0	94.6	0.4
Rural	2.44 ± 0.33	7.0	92.4	0.6

The protein intake among the residents in the disease areas was found to be close to the recommended standard, *i.e.* 0.75 g/kg body weight (Table 2). But in the rural areas, more than 80% of the protein was supplied from plant sources. Consumption of calcium was found to be very low. Furthermore, most of the calcium ingested was obtained from plant sources. The protein and calcium intakes by the suburban residents were higher than those by the rural residents.

TABLE 2. Daily protein, calcium and phosphorus intake by adults

Nutrient	Daily Intake	
	Suburban	Rural
Protein (g)	78.4 ± 3.2	57.7 ± 2.6
Plant source	45.3 ± 6.5	48.3 ± 8.9
Animal source	33.1 ± 0.8	9.4 ± 4.0
Calcium (mg)	432 ± 12.1	262 ± 16.2
Plant source	274 ± 14.2	211 ± 18.7
Animal source	158 ± 8.3	51 ± 10.6
Phosphorus (mg)	1740 ± 27.4	1753 ± 31.8

The average body weight of the residents under study, calculated by a modified Broca's method, was found to be close to the standard value. No significant differences in body weight were observed between suburban and rural residents (Table 3). Results of blood chemistry tests showed normal values for blood composition, reflecting normal functioning of the liver and kidneys.

TABLE 3. Comparison of height and weight of adults (mean  $\pm$  SD)

Area	Sex	N	Height (cm)	Body weight (kg)
Suburban	Male	42	159.8 $\pm$ 5.0	58.1 $\pm$ 7.8
	Female	52	150.2 $\pm$ 6.0	51.5 $\pm$ 7.1
Rural	Male	52	158.5 $\pm$ 6.0	55.3 $\pm$ 7.1
	Female	68	149.3 $\pm$ 5.0	49.9 $\pm$ 5.7

The incidence rates of dental fluorosis among 1,100 children from the study areas were found to differ markedly, depending on whether or not the children consumed milk. The rate of dental fluorosis of the milk-drinking group was 7.2%, whereas that of the non-milk-drinking group was 37.5% (Table 4).

TABLE 4. Incidence of dental fluorosis among children

Group	N	Cases	Incidence rate (%)
Milk-drinking	181	13	7.1
Non-milk-drinking	929	348	37.4

#### DISCUSSION

Results of physical and nutrition examinations indicated that the average adult body weight of the two areas under study was in accord with the standard values. However, while the average protein intake by the residents in the disease areas was close to the recommended standard, i.e., 0.75g/kg body weight,<sup>5</sup> the intakes by the suburban residents were 37% higher than those by the rural residents. Furthermore, most (83%) of the protein consumed by the rural residents was found to be derived from plant sources. By contrast, in the suburban areas, the residents' protein derived from plant sources accounted for only 58%.

More strikingly, the average daily calcium intake by the rural residents was only about one-third of the level recommended by the Chinese Society of Nutrition Science, i.e. 800 mg/day/person. Although calcium intake of the suburban residents was higher than that of the rural residents, it was still below the standard. In the digestive tract, calcium mixes with proteins, amino acids, and sugars to form soluble complexes, enhancing its absorption. In Pingxiang district, especially in rural areas, most of the calcium was derived from plant foods. The levels of oxalate, phytate, and phosphate in such foods are, therefore, high. As is widely known, these chemical substances will react with calcium ions, forming insoluble salts and thus reducing calcium absorption. Also, the ratio of calcium to phosphorus between 2:1 and 1:1 in food is considered favourable to calcium absorption. Results of the nutrition survey indicated that the average Ca:P ratio of the residents diet was far below this ratio. Such low Ca:P ratio may lead to reduced calcium absorption, also. Moreover, an insufficient supply of calcium in the diet would result in lowered CaF<sub>2</sub> formation, thus increasing the absorption of fluoride.

In summary, although the daily fluoride intake by the rural residents was 2.44 mg/person, compared with 3.20 mg/person by the suburban residents, the rural residents had more than 30% higher incidence of dental fluorosis. Furthermore, dental fluorosis incidence rate in milk-consuming children was shown to be only one-fifth that in non-milk-consuming children. These results strongly suggest that inadequate intakes of protein and calcium are important factors contributing to fluorosis, and that an increase in the intakes of both calcium and protein while decreasing the intake of fluoride appears to be an important preventive medicine for the residents under study.

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