Fluorosis of deciduous teeth and first permanent molars in a rural Kenyan community

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The severity and distribution of fluorosis in the deciduous dentition of 76 children in a low-income community near Nairobi were studied. Seventeen children comprised a low-F (fluoride) group (water < 0.7 ppm F) and 59 a high-F group (water ≈ 9 ppm F). The high-F group had scores ≥5 in the Thylstrup & Fejerskov classification system for 29% of the deciduous tooth surfaces, compared with 7% in the low-F group. Comparison between the scores of the second deciduous and the first permanent molars showed no significant difference in the high-F group ($p > 0.10$), whereas the deciduous molar was significantly less severely affected in the low-F group ($p < 0.001$). The deciduous molars of the two groups differed significantly ($p < 0.002$), but not the permanent molars ($p > 0.10$). Early introduction of tea might have been a major contributor to the distributions of fluorosis, particularly in the low-F group. □ *Fluoride; mineralization; pedodontics; primary teeth; tea; water*

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The classical studies of dental fluorosis reported, almost without exception, that the deciduous teeth were not or only rarely affected (1). It has later, however, been well established that fluorosis also occurs in the primary dentition, but usually in milder forms than in the corresponding permanent teeth (2, 3). In Eastern Africa there is a high prevalence and severity of dental fluorosis. Thirty to 50% of the Kenyan population displays signs of dental fluorosis, but with regional differences in prevalence and severity (4, 5).

The community selected for the present study has some households that use surface water with a low-fluoride (F) level, whereas others use borehole water with a high-F level. Studies in the community on the daily intake of F through food and beverages have shown a very high F intake, even by infants (6, 7). The present report deals with the fluorosis of deciduous teeth and first permanent molars in the children of this community.

Materials and methods

Community

The community is located on a coffee plantation 25 km northeast of Nairobi. The clinical examination was carried out from April to July 1986. At that time the total population was 520, of which 260 were aged 0 to 17 years. A 165-m-deep borehole sunk in 1950 supplied water to 5 taps that served 109 households, whereas 31 households collected their water from 2 taps that received surface water from 2 dams. The studies were greatly facilitated by the good rapport established with the community.

Study groups

High-F group. This group comprised all children with deciduous teeth who were born and reared in households using borehole water. These criteria were fulfilled by 59 children—28 boys with a mean age of 5.4

years (range, 1–12 years) and 31 girls with a mean age of 5.6 years (range, 1–13). Fifteen of the children had a complete deciduous dentition.

Low-F group. This group comprised all children with deciduous teeth who were born and reared in households using surface water. These were 17 children—10 boys with a mean age of 8.1 years (range, 1–11) and 7 girls with a mean age of 5.3 years (range, 1–9).

Dental examination

The buccal and lingual tooth surfaces were scored for fluorosis in accordance with the Thylstrup & Fejerskov (TF) classification system (8). Teeth less than half erupted were excluded. If the examiner was in doubt as to which TF score should be assigned, the lower score was chosen. The children were examined in shaded daylight with plane mirrors and probes. Their teeth were cleaned and dried with gauze and cotton rolls before examination.

Water

Water samples were collected monthly over a year directly from the borehole and the two dams and also from each of the seven communal water taps. The F concentrations were determined with a digital pH meter (3020 Orion, Cambridge, Mass., USA) and a F-specific ion electrode (96–09 Orion).

Statistical methods

The chi-square method served to test differences between girls and boys, whereas a

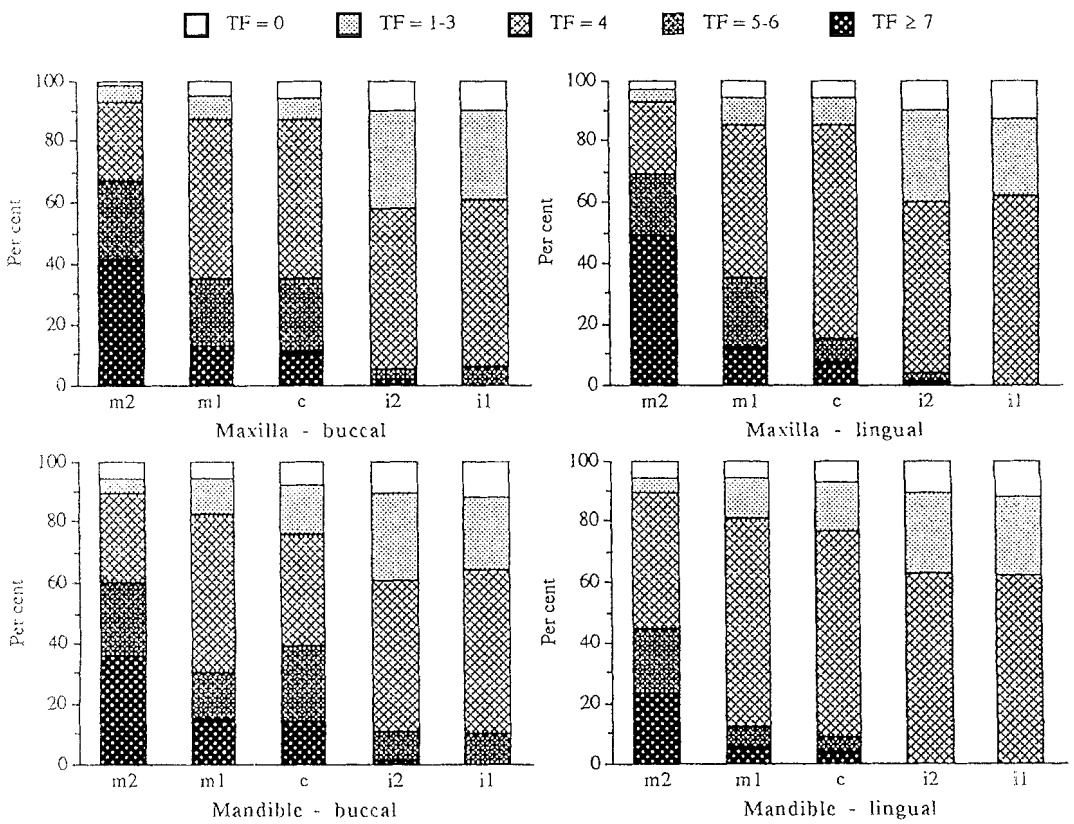

Fig. 1. Distribution of fluorosis scores on buccal and lingual surfaces of deciduous teeth in the upper and lower jaw of 59 children from households supplied with high-F water. TF = Thylstrup & Fejerskov classification system.

Mann–Whitney U-test was used for comparing the severity of fluorosis in children from households with high- and low-F water (9).

Results

High-F group

The fluorosis scores of the 1706 buccal and lingual deciduous tooth surfaces of the 59 children were distributed as follows: 7%, TF score 0; 14%, score 1–3; 50%, score 4; 15%, score 5–6; and 14%, score ≥7 (Fig. 1). In both jaws the second molars were most and the incisors least affected. The canines showed the most noticeable difference between buccal and lingual scores, being more affected on the buccal side.

Low-F group

The fluorosis scores of the 456 buccal and lingual deciduous tooth surfaces of the 17 children were distributed as follows: 58%, TF score 0; 11%, score 1–3; 24%, score 4; 3%, score 5–6; and 4%, score ≥7. Fig. 2B presents the severity of fluorosis in accordance with tooth type.

Second deciduous versus first permanent molar

In children with second deciduous and first permanent molars the TF scores on the buccal surfaces of these teeth were compared (Fig. 3). The TF scores in children from households with high-F water averaged 6.7 on deciduous and 7.5 on permanent molars, whereas the respective means were 2.5 and 6.3 in children from households with low-F water. Comparison of the two groups showed no significant difference in the scores of the permanent molar ($p > 0.10$), but the fluorosis of the deciduous molar was significantly less severe in children from households with low-F water ($p < 0.001$). Comparison of the fluorosis of the deciduous and permanent molars showed no significant difference in children from households with high-F water ($p > 0.10$), whereas the deciduous molar was significantly less severely affected in the group with low-F water ($p < 0.002$).

Girls versus boys

No significant sex difference was disclosed by comparison of the fluorosis in boys and girls from households using high-F

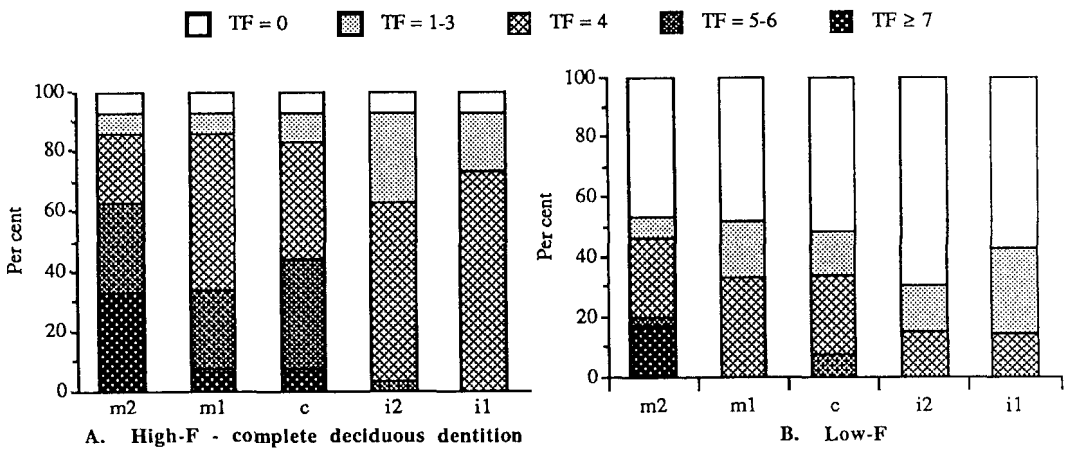

Fig. 2. Distribution of fluorosis scores of the buccal surfaces of deciduous teeth in the maxilla of (A) 15 children with complete deciduous dentition from the households supplied with high-F water, and (B) 17 children from households supplied with low-F water. TF = Thylstrup & Fejerskov classification system.

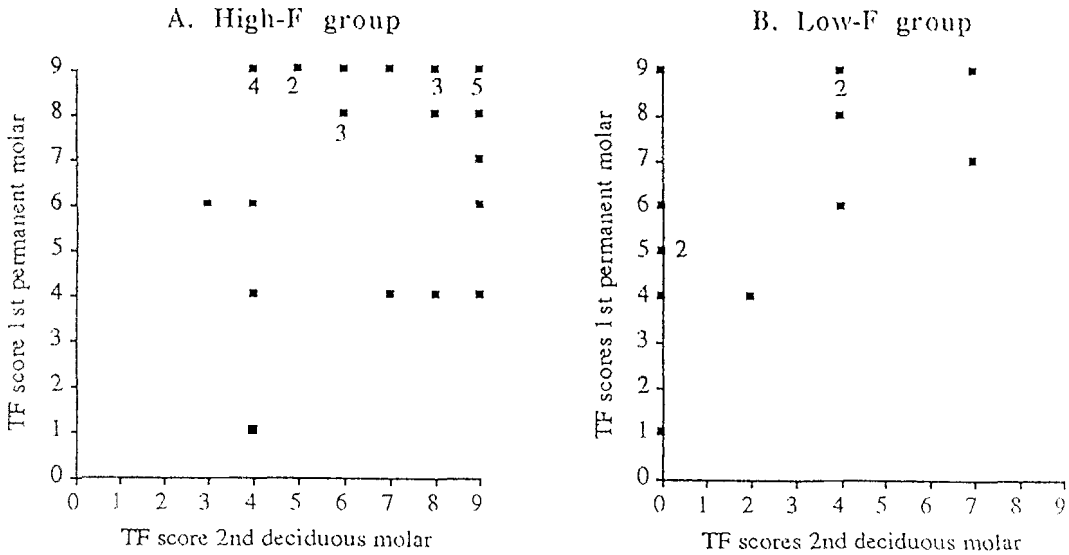

Fig. 3. The Thylstrup & Fejerskov (TF) classification scores on the buccal surfaces of the second deciduous molar and the first permanent molar in (A) 30 children of households supplied with high-F water and (B) 13 children from households supplied with low-F water.

water. The mean TF scores on the second deciduous molar were 5.8 in girls and 6.1 in boys (chi-square = 0.17, df = 1) and on the first permanent molar 7.3 in girls and 7.5 in boys (chi-square = 0.52, df = 1).

Water samples

The mean annual F concentrations were 0.24 ppm (range, 0.17–0.60) and 0.65 ppm (range, 0.60–0.75) in the water of the two taps supplied with surface water (Fig. 4). Over the year there were rather large fluctuations in the F level of the water originating from the borehole. The mean concentration of the borehole water was 9.2 ppm F (range, 6.6–11.1), whereas the mean level of the 60 samples from the 5 taps supplied with water from the borehole was 9.1 ppm F (range, 6.0–11.7).

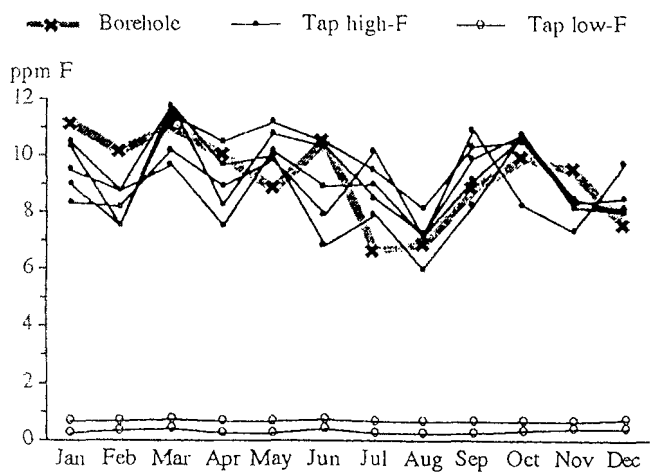

Fig. 4. Annual variations in F levels in water from a borehole, taps supplied with water from the borehole (Tap high-F), and taps supplied with water from two dams (Tap low-F).

Discussion

The present distribution of fluorosis in the deciduous dentition agrees with the findings in Tanzania by Thylstrup (3), who reported a progressive increase in the severity from the anterior to the posterior teeth and a tendency for the maxillary canines and the mandibular teeth to be more severely affected on the buccal than on the lingual surfaces. Some studies have shown tendencies towards more severe dental fluorosis in boys than in girls (2, 10), and larger intake of F by boys has been suggested as an explanation (2). The present boys and girls displayed no significant difference in the degree of fluorosis, which is consistent with the finding that boys and girls of this community had essentially the same intake of F through food and beverages (6).

Development of dental fluorosis is closely related to the F supply during the period of tooth mineralization. The crowns of the deciduous teeth are about halfway mineralized by birth and become fully formed during the first 12 months of postnatal life (11). About 80% of the deciduous teeth of children from households using high-F water had TF scores of 4 or more. This high percentage of marked fluorosis is consistent with the high F intake by the children of these households during critical stages of tooth formation (6). Except for a 2-week-old child being breastfed only, all the other 18 children below the age of 1 year were found to receive substantial amounts of F through breast milk supplements. In 0- to 6-month-olds the average was 0.63 mg F/kg body weight (range, 0.23–1.09; $n = 9$), and in 7- to 12-month-olds 0.68 mg F/kg bwt (range, 0.27–1.42; $n = 9$). Assuming this magnitude of F exposure for the present children, it is actually noticeable that about 20% of the deciduous tooth surfaces were given TF scores lower than 4. It may also be noted that about 30% of the deciduous tooth surfaces of children from households that claimed to use low-F water had scores of 4 or more. Several factors may have contributed to this. It may partly reflect an inherent biologic variation in the susceptibility to develop fluorosis. Another likely reason is that the children might have received food and beverages on visits outside the household.

Unfortunately, few data are available on the quantitative intake of F during the 1st year of life by children of households with low-F water. It can be noted, however, that two children of low-F households, aged 17 and 22 months, had daily intakes of 0.89 and 0.92 mg F/kg bwt (Opinya et al., unpublished results). About 60% of this F was consumed as tea. Most children of the community were introduced to tea during the first months of life.

In children possessing both the second deciduous molar and the first permanent molar, these teeth were compared for severity of fluorosis. Nearly half of the children from households with high-F water had equal or higher F scores on the deciduous tooth, whereas not a single child from households with low-F water displayed a higher score on the deciduous than on the permanent tooth (Fig. 3). Apparently, there had been a difference between the two groups in the F exposure during the mineralization of the deciduous molar, whereas the fluorosis of the permanent molar reflected no difference in F exposure. The mineralization of the second deciduous molar starts in the second trimester and it has the crown completed about 10–11 months postnatally. The mineralization of the first permanent molar commences at birth, but it takes more than 3 years before the crown is completed (11). It seems that most of the children from the households with low-F water had a relatively low F exposure during the first months of life but that they thereafter had an intake of F that manifested as severe fluorosis. The age when tea was introduced might have been a main determinant for development of fluorosis, particularly in children from households with low-F water.

Over the year there were considerable fluctuations in the F level of the borehole water. We are puzzled and unable to explain why the F levels in samples collected on the same occasion from the borehole and from taps supplied with water from the borehole often differed considerably (Fig. 4).

It turned out that several factors varied more than initially expected and modulated

the development of dental fluorosis in the children of this rather homogeneous low-income society. To obtain more exact and reliable information, it seems advisable to select and compare small and very well-defined groups of mothers and children with different F exposure and living conditions. In these children the F intake from various sources should then be closely and frequently monitored, in addition to their nutritional status, diseases, and other factors that may affect the development of fluorosis. By relating this specific information to the resulting fluorosis, clues might be provided for a better understanding of the various factors that determine and modulate the development of fluorosis.

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