We have examined the prevalence of dental fluorosis and the occurrence of skeletal fluorosis in communities in Senegal with different fluoride concentrations in the drinking water.

MATERIALS AND METHODS

Data were collected by two authors (I. B. and A. de B.) in October and November, 1985, at the beginning of the dry season. The study consisted of two surveys.

First Survey

The first survey was of the prevalence of dental fluorosis in five towns (Nioro du Rip, Kaffrine, Gossas, Guinguineo, Foundounagou) in the Sine Saloum region with fluoride concentrations in the drinking water of <0.1 to 4.6 mg/l. In each town, 50-80 elementary school children (7-9 years) who had used these sources of water since birth were examined. Those who did not have permanent incisors yet were excluded. For every child the mottling of the enamel of the eight permanent incisors was scored according to Dean's classification. The score per child was based on the two most affected teeth. A first morning urine was collected from 20 of the boys examined in each community. The community index of fluorosis (Fc) was calculated according to Dean’s method:

\[
Fc = \frac{\text{number of children} \times \text{Dean's index score}}{\text{Total number of children examined}}
\]

Second Survey

The second survey was conducted at Nioro du Rip, Guinguineo, and Darou Rahmame Fall (Dioirlab region). In these places the drinking water contained fluoride in concentrations of <0.1 mg/l, 3.9 mg/l, and 7.4 mg/l, respectively, and the sources had been in use for more than 20 years. Both children and adults were examined in the second survey.

Children.—In each of the three towns about 50 randomly selected children (7-16 years) who had lived there since birth were examined. In Nioro du Rip and Guinguineo the children were recruited from elementary schools, whereas in the village of Darou Rahmame Fall all children aged 9-16 years available at the time of the survey were examined. The prevalence of dental fluorosis was examined in more detail in the second than in the first survey: the eight permanent incisors of every child were individually scored as 0, 0.5, 1, 2, 3, or 4 according to Dean’s classification. The score per child was based on the two most affected teeth. A first morning urine was collected from 20 of the boys examined in each community. The community index of fluorosis (Fc) was calculated according to Dean’s method.

\[
Fc = \frac{\text{number of children} \times \text{Dean's index score}}{\text{Total number of children examined}}
\]

Adults.—In the two communities with the highest level of fluoride in the drinking water, Guinguineo and Darou Rahmame Fall, about 50 residents aged 40-60 years who had lived in these areas all their lives were randomly selected from each community and examined for the presence of obvious kyphosis as a visible sign of possible serious skeletal fluorosis. X-rays were taken in Fann Hospital, Dakar, of the vertebral column, hand, and wrist of 3 adults in Darou Rahmame Fall with serious kyphosis. The X-rays were interpreted at Fann Hospital and by specialists at the Academic Hospital, Utrecht, the Netherlands.

Fluoride Analysis

The fluoride concentrations of the samples of morning urine and drinking water were measured with a fluoride ion-specific electrode.

Statistics

The data on the prevalence of kyphosis were statistically analysed by means of the \(z\)-test.

RESULTS

The first survey clearly showed that the prevalence of dental fluorosis among children increases with the fluoride...
The mean (SD) fluoride concentrations in the morning urine of the children were 0.7 (0.6) mg/l in Niou du Rip, 12.0 (6.2) in Guinguineo, and 17.9 (11) in Darou Rahmene Fall. Among adults kyphosis was more prevalent in Darou Rahmene Fall than in Guinguineo (table IV) (p = 0.025). In 3 adults from Darou Rahmene Fall with kyphosis X-rays of the vertebral column, hand, and wrist confirmed the diagnosis of skeletal fluorosis.

**DISCUSSION**

In this survey the prevalence of dental fluorosis among children aged 7-9 years was already very high at fluoride levels in the drinking water of about 1 mg/l. The 1.5 mg/l fluoride recommended by WHO as maximum acceptable concentration in the drinking water obviously cannot be applied to Senegal. The hot and dry climate in Senegal, and consequently high levels of water intake, may account for the high prevalence of dental fluorosis, as suggested by the way in which countries with different climates but similar fluoride levels in drinking water differ in community indices of fluorosis (table IV); this positive relation between the degree of dental fluorosis and the environmental temperature was first published in 1953.

In temperate climates the fluoride concentration in the urine is similar to the fluoride concentration in the drinking water. In this study children had urinary fluoride concentrations that were about 2.5 times higher than the fluoride concentration in drinking water. High sweat loss and high water intake may be responsible for high serum fluoride levels and hence dental and skeletal fluorosis. If climate does strongly influence the appearance of dental fluorosis in the community, then in places with hot climates skeletal fluorosis could be expected to become apparent at lower fluoride concentrations in the drinking water than it does in a milder climate. In the 1984 WHO guidelines for drinking water quality the minimum drinking water fluoride concentration beyond which crippling fluorosis occurs is said to be 10 mg/l. However, that same year, another WHO publication Fluorine and Fluorides cited a report which was based on balance studies on patients with endemically fluorosis, and which indicated that in adults a daily intake exceeding 8 mg would be harmful. The X-rays taken in Senegal confirmed that crippling skeletal fluorosis occurs at 7.4 mg/l fluoride in the drinking-water. At this concentration a daily water intake of 2 litres by adults (which is a low intake in view of the climatic conditions in Senegal), would correspond to a probable intake of 15 mg fluoride per day. The high prevalence of kyphosis in Senegal at 7.4 mg/l fluoride in drinking water is a serious health problem. We could not collect data on the prevalence of skeletal fluorosis at drinking water fluoride concentrations of 7.4 mg/l or less.

The disfiguring brownish-black discolorations in the enamel of the teeth are an especially serious aesthetic problem. We could not collect data on the prevalence of skeletal fluorosis at drinking water fluoride concentrations of 7.4 mg/l or less.

![Graph](image-url)

**TABLE I—PREVALENCE OF DENTAL FLUOROSIS AMONG CHILDREN AGED 7-9 YEARS IN COMMUNITIES WITH DIFFERENT FLUORIDE CONCENTRATIONS IN DRINKING WATER.**

<table>
<thead>
<tr>
<th>Community</th>
<th>Fluoride concentration (mg/l)</th>
<th>Number of children examined (% of total)</th>
<th>Prevalence of dental fluorosis (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Niou du Rip</td>
<td>&lt;0.1</td>
<td>83</td>
<td>2.4</td>
</tr>
<tr>
<td>Kaffrine</td>
<td>1.1</td>
<td>73</td>
<td>68.5</td>
</tr>
<tr>
<td>Gossas</td>
<td>2.6</td>
<td>75</td>
<td>85.3</td>
</tr>
<tr>
<td>Guinguineo</td>
<td>3.9</td>
<td>63</td>
<td>63.7</td>
</tr>
<tr>
<td>Foundiouagne</td>
<td>4.6</td>
<td>54</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*Dean's index > 1.

**TABLE II—SEX AND AGE OF CHILDREN EXAMINED IN SECOND SURVEY.**

<table>
<thead>
<tr>
<th>Community (mg F/l)</th>
<th>Number of children examined</th>
<th>Mean (SD) age (yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Niou du Rip (&lt;0.1)</td>
<td>28 Boys 22 Girls 50 Total</td>
<td>8.7 (0.9)</td>
</tr>
<tr>
<td>Guinguineo (3.9)</td>
<td>24 Boys 30 Girls 54 Total</td>
<td>8.6 (0.9)</td>
</tr>
<tr>
<td>Darou Rahmene Fall (7.4)</td>
<td>28 Boys 20 Girls 48 Total</td>
<td>10.4 (2.7)</td>
</tr>
</tbody>
</table>

**TABLE III—PREVALENCE OF KYPHOSIS AMONG ADULTS AGED 40-60 YEARS IN GINGUINEO AND DAROU RAHMANE FALL IN RELATION TO THE FLUORIDE CONCENTRATIONS IN THE DRINKING WATER.**

<table>
<thead>
<tr>
<th>Community</th>
<th>Fluoride concentration (mg/l)</th>
<th>Number of persons examined</th>
<th>Number (%) with kyphosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guinguineo</td>
<td>3.9</td>
<td>55 Total 4 (7.3)</td>
<td></td>
</tr>
<tr>
<td>Darou Rahmene Fall</td>
<td>7.4</td>
<td>42 Total 11 (26.2)</td>
<td></td>
</tr>
</tbody>
</table>

The disfiguring brownish-black discolorations in the enamel of the teeth are an especially serious aesthetic problem. We could not collect data on the prevalence of skeletal fluorosis at drinking water fluoride concentrations of 7.4 mg/l or less.
REFERENCES


Infection Today

SURGICAL PROPHILAXIS—THE EMERGING PICTURE

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Infection continues to be the most important cause of the failure of surgical operations despite the development of more and more powerful antimicrobial drugs. It is accepted that infection can occur only when pathogens invade the tissues in sufficient numbers to overcome the normal humoral and cellular defences of the body. The role of antimicrobial drugs is to reduce the number of invaders to a manageable level. It is equally true that the host's ability to resist infection can be reduced by gross malnutrition, by tissue destruction including clumsy surgery, by prolonged anaesthesia, and by ischaemia, whereas the only proven way of enhancing host resistance is to ensure an adequate supply of oxygenated blood to the tissues that are contaminated by bacteria.

Infections in surgical patients arise as a result of exogenous or endogenous bacterial contamination, either in the operating theatre or in the wards. They may affect the tissues at the site of operation—wound infections and intra-abdominal or intrathoracic infections—or they may occur at distant sites, most often in the respiratory and urinary systems. The prophylaxis of each of these infections differs in detail, but the principles are the same—to avoid or minimise bacterial contamination, to use antibiotics intelligently, and to do nothing to compromise the host's ability to defeat the invaders.

TRAUMATIC WOUNDS (TABLE I)

Tissue destruction is one of the most potent predisposing causes of infection, and its extent depends on the kinetic energy of the penetrating object. High velocity missile wounds, therefore, cause massive tissue destruction. Knives are relatively, and bullets absolutely, sterile and bacterial contamination occurs from exogenous sources or by penetration of a hollow viscus. Wounds inflicted in road traffic accidents and by human or animal bites are always contaminated.

The prophylaxis of infection entails, firstly, the immediate injection (preferably intravenously) of an antibiotic (the choice depending on the likely microbial contaminants), the injection of a booster dose of tetanus toxoid if there has been a chance of soil contamination, and the injection of a booster dose of tetanus toxoid if there has been a chance of soil contamination, and, then, if indicated by the extent of the injury, vigorous antimicrobial treatment. The principles of such antibiotic therapy differ in detail, but the principles are the same—to avoid or minimise bacterial contamination, to use antibiotics intelligently, and to do nothing to compromise the host's ability to defeat the invaders.

References continued at foot of next column

1. D. BROUWER AND OTHERS: REFERENCES—continued


