

## Fluoride in drinking water

### Investigating the effects of fluoride in drinking water on human health and nutrition in the Northern Cape.

#### Population of the Northern Cape

The Northern Cape is the largest province in South Africa, with a land area of 361 830 km<sup>2</sup>, covering almost a third of the total area of the country. It is also the province with the smallest population (823 000 according to the 2001 census).

The education levels in the Northern Cape are low, with an estimated 79% of the entire adult population age 20 years and older in 1996 having less than 12 years of schooling. Almost half of the population (43% in 1996) is not economically active, while a relatively large percentage of those who are employed, are in the lowest income bracket.

#### Pros and cons of fluoride in drinking water

Information regarding health implications of fluoride in water is readily obtainable in literature published internationally, e.g.:

- Water is generally considered safe and healthy at levels used for water fluoridation when present in the concentration range (either naturally occurring or resulting from fluoridation) of 0,7 to 1,2 mg/ℓ.
- Community water fluoridation is safe and effective in preventing tooth decay. The balance of evidence suggests that rates of dental decay are lower in communities with fluoridated water supplies than those with non-fluoridated water. The fluoride effect tends to be more pronounced in deciduous teeth.
- Children of eight years or younger in communities living in areas with natural fluoride concentrations greater than 2 mg/ℓ are at increased risk of severe enamel fluorosis, a condition that causes staining and pitting of the enamel surface of teeth. At lower levels enamel fluorosis is mild and mainly of aesthetic concern.
- Communities living in areas where fluoride levels are greater than 4 mg/ℓ and having a lifetime exposure to fluoride are likely to experience increased bone fracture rates, particularly so for some demographic subgroups that are prone to accumulate fluoride into their bones (e.g. people with renal disease).

There is some evidence that water fluoridation reduces the inequalities in dental health across social classes in the five to 12-year age group.

#### Investigating exposure to fluoride in the Northern Cape

An opportunity to test this published information with reference to conditions prevailing in the Northern Cape (i.e. water resources, water quality – specifically fluoride content – and socio-economic conditions) arose when it was decided to investigate the health and nutritional status of sections of the Northern Cape population in relation to fluoride concentrations in drinking water. In carrying out the investigation:

- Levels of fluoride in the groundwater supply used for human consumption in the Northern Cape were determined;
- Clinical studies were carried out on selected samples of children to assess their nutritional status as well as dental health associated with different levels of fluoride; and
- The potential of appropriate and inexpensive technology for defluoridation of high-fluoride drinking water was assessed.

Samples of drinking water were collected for the analysis of free fluoride ions from 81 towns in the Northern Cape. More specific samples were collected from different school sites in the diamond fields (i.e. Kimberley and surrounding per-urban area), de Aar, Leliefontein and Kamassies. A total of 954 children at these schools were examined for nutritional status (as reflected in height and weight), dental caries and fluorosis. Schools were selected to provide a stratified sample for true representation of conditions in the province.

#### Results of the investigation

The fluoride levels for the Northern Cape ranged from < 0,05 to 8,2 mg/ℓ. The average fluoride levels of major towns with centralised water supply were 0,31 to 0,35 mg/ℓ. De Aar, which makes use of a borehole water supply, had a fluoride level of 0,71 mg/ℓ. The fluoride levels of Leliefontein

and Kamassies' borehole water supplies ranged from 0,2 to 2,5 mg/ℓ.

Within the above range of fluoride levels, there was no discernable correlation between fluoride concentration and the percentage of caries-free children. The percentage of caries-free children with primary teeth in the age group three to five years ranged from 25% (De Aar) to 45% (Kimberley).

With all sampled areas having naturally occurring fluoride, it was expected that there would have been a greater percentage of caries-free children. It was mainly the peri-urban areas around Kimberley and to a lesser extent the Kamassies area that came the closest to meeting this expectation.

With regard to permanent teeth, data on decayed, missing and filled teeth revealed very low prevalence of dental caries in the 11- to 13-year age group in the whole Northern Cape.

Fluorosis encountered in different parts of the province varied from mild to severe, with Kamassies, Leliefontein and the peri-urban area around Kimberley having particularly high frequencies of mild fluorosis. The mild fluorosis prevalent in these areas and, to a lesser extent in Kimberley itself, was in spite of low levels of fluoride (about 0,34 mg/ℓ). The explanation for the greater-than-expected occurrence of mild fluorosis could lie in the uptake of supplementary fluoride through toothpastes, milk, etc.

There was no difference in nutritional status of the sample population between Kimberley and the surrounding peri-urban areas on the one hand, and De Aar on the other. Using World Health Organisation criteria, just over 20% of children displayed either malnutrition or both malnutrition and stunting.

In conclusion, the study indicated that fluoride levels of around 0,3 mg/ℓ generally have a beneficial effect on permanent teeth, but have little effect on the primary teeth of young children.

## Defluoridation – an option to be considered

Clearly, fluoride levels in drinking water higher than 1,5 mg/ℓ may cause multidimensional health problems, including not only mottling of teeth and dental fluorosis but also several neurological disorders. At such elevated levels, the removal of excessive fluoride through defluoridation must be considered. Several methods of defluoridation are available. They generally fall into two categories, namely precipitation and adsorption.

There are methods that are in use in developing countries that are suitable for either large-scale fluoridation plants or for domestic/household use. Some of these have been reviewed as part of this investigation with a view to possible adaptation and use in the Northern Cape and elsewhere in South Africa where fluoride might be a problem.

### Further reading:

To obtain the report, *Fluoride in Drinking Water and Its Effects on Human Health and Nutrition in Selected Towns of the Northern Cape Province, South Africa (Report No: 1094/1/08)*, contact Publications at Tel: (012) 330-0340; Fax: (012) 331-2565; E-mail: [orders@wrc.org.za](mailto:orders@wrc.org.za); or Visit: [www.wrc.org.za](http://www.wrc.org.za)