Oral Health

Water, Sanitation and Health Theme Article

Links: Other articles related to this theme: Water and Natural Hazards; Water Scarcity; Water Challenges; Water for Positive Health

Disease fact files:

Dental caries
Fluorosis
Malnutrition
Noma

Summary:

• Good oral health depends on a safe water supply
• Tooth decay (dental caries) is a worldwide problem
• Water related malnutrition is an important factor in poor oral health
• Fluoridation of water supplies significantly improves dental health in regions with low natural fluoride in the water
• Naturally high levels of fluoride may cause fluorosis and in some regions defluoridation programmes or alternative water supplies are required

Introduction

“The man with toothache thinks everyone happy whose teeth are sound”
George Bernard Shaw, 1856-1950, in 'Man and Superman’

“Every Tooth in a Man’s Head is more valuable than a Diamond”
Miguel de Cervantes (1547-1616) in Don Quixote.

Healthy teeth are essential to general health. This theme article examines the problem of dental decay and the role water plays in maintaining dental health, including fluoride levels, diet and hygiene.

Dental caries: A worldwide epidemic

Dental caries (Box 1) affects the majority of populations in industrialized and many developing countries. It is characterised by the dissolution of the dental enamel and dentine. This eventually destroys the affected tooth surface or the tooth itself. The immediate cause is organic acid produced by micro-organisms present on the tooth. Dental plaque consists of bacteria and a matrix of extracellular polysaccharides produced from sucrose by the bacteria. Tooth plaque, specific bacteria, diet, fluoride
and saliva are all involved in the dental caries process. In recent decades, preventive measures have helped to dramatically lower levels of dental caries in industrialized populations. The most important of these measures is exposure to an appropriate level of fluoride, from various sources, including water, food and toothpaste.

**Box 1: Dental caries**

Dental caries is a multifactorial disease, related to:

- the presence of microorganisms that cause caries, such as *Streptococcus mutans*, and *Streptococcus sobrinus*

- fermentable carbohydrates (e.g. sugars) in the diet, particularly when consumed frequently

- susceptible teeth, such as in the early stages of development, after injury or in malnutrition or chronic disease

- time: caries increase over time as teeth erupt and surfaces become at risk

**Water fluoridation**

Many communities worldwide lack sufficient natural fluoride in their drinking water to prevent caries. Because of the powerful benefits of the right amount of fluoride, water fluoridation programmes (Box 2) have been established in many countries since the 1930s when its ability to reduce dental caries was first recognized.

**Box 2: What is a fluoridation programme?**

A fluoridation programme is the artificial and controlled addition of a fluoride compound to a public water supply, in order to adjust its fluoride concentration to an optimal level for prevention of dental caries. The optimal level is usually around 1mg/litre. A fluoride-containing chemical is added to increase the total (raw water plus dosed) level to the pre-determined concentration. The chemical is chosen for its ability to dissolve in water, low cost and lack of undesirable side effects. Fluoride is odourless and tasteless, so there is no perceptible change to the water. The usual chemicals used for fluoridation are: hexafluorosilicic acid, disodium hexafluorosilicate or sodium fluoride. Fluoridation is carried out at water treatment works. A fluoridation programme requires good maintenance and a specially designed plant: fluoridation chemicals are corrosive in concentrated form and must be stored and handled according to safe working practices.

Water fluoridation in low fluoride-containing water supplies helps to maintain optimal dental tissue development and dental enamel resistance against caries attack during the entire life span. Fluoride in drinking water acts mainly through its retention in dental plaque and saliva. Frequent consumption of drinking water and products made with fluoridated water maintain intra-oral fluoride levels. People of all ages, including the elderly, benefit from community water fluoridation. For example, the prevalence of caries on root surfaces of teeth is inversely related to fluoride levels in the drinking water.
water: in other words, within the non-toxic range for fluoride, the higher the level of fluoride in water, the lower the level of dental decay. This finding is important because with increasing tooth retention and an aging population, the prevalence of dental root caries would be expected to be higher in the absence of fluoridation.

Fluoridation of water supplies, where possible, is the most effective public health measure for the prevention of dental decay. Water fluoridation is a multi-professional activity in which engineers, chemists, physicians, nutritionists and dentists all play important roles. The efficiency of fluoridation programmes, and their acceptability to the communities, depends on the general state of dental health and whether there is good access and attendance for free dental health care for children and young people, as well as high standards of diet and oral hygiene.

The consensus among dental experts is that fluoridation is the single most important intervention to reduce dental caries, not least because water is an essential part of the diet for everyone in the community, regardless of their motivation to maintain oral hygiene or their willingness to attend or pay for dental treatment. In some developed countries, the health and economic benefits of fluoridation may be small, but particularly important in deprived areas, where water fluoridation may be a key factor in reducing inequalities in dental health.

**Dental fluorosis**

**Dental fluorosis** is a specific disturbance of tooth formation caused by excessive fluoride intake during the development of teeth. It is characterized by opaque white patches in the dental enamel. These patches may become stained yellow to a darker colour and in more severe cases normal tooth structure may be destroyed. The degree of fluorosis, and plasma and bone fluoride levels, are directly related to the concentration of fluoride in drinking water.

When mild or more severe dental fluorosis is found to a significant extent in a community, steps should be taken to reduce fluoride ingestion during the ages of tooth development. Excessive levels of fluoride in the drinking water can lead to more serious health problems, notably skeletal fluorosis and other effects on the skeleton. In its extreme form, skeletal fluorosis is a very seriously debilitating disease. Because of excessive total intakes of fluoride in many parts of the world, skeletal fluorosis affects several millions of people.

In drinking water, fluoride is tasteless, odourless, colourless and totally soluble and its detection requires laboratory equipment and specially trained personnel. Methods for removing excess fluoride are well established, although the prevention of fluorosis through the treatment of drinking water requires favourable socio-economic conditions. The provision of a safe low level of fluoride in water from alternative sources should be investigated as a first option. Defluoridation of water may be the only option to prevent fluorosis if alternative supplies are either not available or too expensive. The methods for defluoridation depend on the specific local circumstances in the community and the level of fluoride concentration in the drinking water. In developing countries, WHO’s initiative has emphasised the effective and less expensive methods that are suitable for individual households, or community defluoridation of water for drinking and cooking.

**Dental health and malnutrition**
The development of healthy normal teeth requires a well balanced diet, particularly rich in Calcium and Vitamin D. Malnutrition, to which water contributes, has a direct effect on this development. A combination of poor diet and poor oral hygiene may result in the appearance of surface damage to the teeth as young as 6-12 months of age (Milgrom et al 2000).

**Noma**

Noma, also known as 'cancrum oris' is a rare but serious oral disease related to poor diet and hygiene. The name is derived from the Greek “nomein” which means “to devour”. It is a gangrene condition that starts in the mouth as an apparently benign oral lesion and rapidly destroys both soft and hard tissues of the mouth and face. Most noma sufferers are under six years of age. It flourishes where poverty is greatest, nutrition is poorest and hygiene is neglected. The disease was not uncommon in Europe and North America in the 18th and 19th Centuries. It disappeared from these continents with social and economic development. Nowadays it is an additional health problem for disadvantaged communities, especially in the African continent. The size of the noma problem is not well documented but it is estimated, by different sources, that there may be more than 100,000 cases. Today noma is treatable, if the disease is detected and recognized at an early stage. Simple and low-cost care can be provided to stop the evolution of the gangrene and to avoid disfigurement. It requires topical antiseptics, provision of antibiotics, nutritional rehabilitation and clean drinking water.

**Oral hygiene and safe water supplies**

Good oral health requires a clean water supply, sufficient for brushing and cleaning teeth regularly from an early age. Poor oral hygiene may also result in periodical problems since the dental plaque may induce gingival inflammation and deep pockets. While fluoride intake from drinking water and a balanced, low sugar diet are probably the most important factors in reducing dental caries, a lack of clean water for basic oral hygiene may tip the balance towards earlier and more severe patterns of caries. Where fluoride concentrations in water or in the diet are known to be low, community water fluoridation is safe and cost-effective. While there are established benefits from adding fluoride to waters with low natural fluoride, fluorosis remains a problem in areas of where the natural concentration of fluoride is high, as discussed in the theme article on natural hazards.

**Further information**

Forss H. Efficiency of fluoride programs in the light of reduced caries levels in young populations. Acta Odontol Scand 1999; 57: 348-351


WHO. Fact sheet on Fluoride - www.worldwaterday.org


WHO. Fluoride in drinking-water (will be available March 2003)

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