

## Fluoride



Fluoride has long been used as a means of protecting the teeth from caries. It can be used in a variety of ways, such as fluoride toothpaste, fluoride rinses, topical fluoride varnish, systemic fluorides (tablets, drops, lozenges and chewing gums), fluoridated milk and targeted water fluoridation. This Fact File examines the evidence for the use of fluoride as a means of preventing dental caries and reducing oral health inequalities.

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## Introduction

Tooth decay is a significant problem in parts of the UK and dental health inequalities are increasing. In socially deprived communities, as many as one in three children under the age of five will have one or more decayed teeth extracted.

Fluoride is a naturally occurring mineral that has a history of being used as a means of reducing dental decay (caries). It can be brought into contact with teeth in a number of ways, including fluoride toothpaste, fluoride rinses, fluoridated milk and topical fluoride varnish. In some areas, fluoride is added to water as a means of reducing caries and tackling oral health inequalities. Although the post-eruptive effect of fluoride is now considered to be more important than the pre-eruptive effect, fluoride supplements where the fluoride is administered systemically can also be used to reduce caries.

## What is fluoride and how does it work?

Fluoride is a mineral found naturally in water and many foods. Bringing teeth into contact with fluoride (topical effect) can make a big difference to the standard of oral health by reducing caries. Dental caries occurs through demineralisation of dental hard tissue. Fluoride works to improve oral health by enhancing remineralisation and reducing the acid production ability of plaque-forming bacteria, thereby protecting against caries.<sup>1</sup> The acids causing demineralisation of dental hard tissue are formed from the action of plaque bacteria on sugars in the diet; therefore it is recommended that the frequency and amount of sugars in the diet should be reduced.<sup>2</sup> A maximum protective effect occurs when teeth erupt into an environment with high concentrations of fluoride.

## Do topical fluorides (toothpaste, varnish, mouthrinses, gel) prevent caries?

The effectiveness of some topically applied fluorides such as toothpaste, varnish and rinses in preventing dental caries has been well established in systematic reviews of randomised controlled trials conducted in children.<sup>3-5</sup>

Regular use of fluoride toothpaste is known to be effective in preventing caries in the permanent dentition.<sup>5</sup> There is an apparent dose response relationship between the amount of fluoride and

the level of caries prevention. A Cochrane systematic review found that the prevented fraction (based on the number of decayed, missing or filled surfaces) was 23 per cent for fluoride at 1,000-1,200 ppm (parts per million) - i.e. the use of toothpaste at this fluoride concentration prevented 23 per cent of the decayed, missing or filled surfaces that would have been observed without use of the toothpaste. This increased to 29 per cent for fluoride concentrations of 1450-1500 ppm, and to 36 per cent for higher concentrations of fluoride (2,400-2,800 ppm). The prevented fraction for 440-550 ppm fluoride was 15 per cent, but this is not statistically significant.<sup>6</sup>

The application of fluoride varnish has also been shown to be effective in both the primary and permanent dentition. The prevented fraction (based on the number of decayed, missing or filled surfaces) in permanent teeth was 46 per cent.<sup>4</sup> The prevented fractions for fluoride gels and mouthrinse were found to be of a similar order to that of toothpaste at 1,000-1,200 ppm, with prevented fractions of 26 per cent for mouthrinses<sup>3</sup> and 28 per cent for gels.<sup>7</sup> A meta-analysis comparing the use of fluoride gel, mouthrinse or varnish combined with toothpaste, compared with toothpaste alone, indicated a 10 per cent prevented fraction.<sup>8</sup>

## Does milk fluoridation prevent caries?

There is insufficient good quality evidence supporting the effectiveness of fluoridated milk in preventing decay.

## Do fluoride supplements (tablets, drops, lozenges or chewing gum) prevent caries?

There is insufficient good quality evidence supporting the effectiveness of fluoride supplements in preventing caries.

## What is the evidence that fluoridated water is beneficial?

Over recent years, two major investigations have taken place in the UK - one in 2000 by the University of York Centre for Reviews and Dissemination<sup>9</sup> and the other in 2002 by the Medical Research Council (MRC).<sup>10</sup> Additional substantive reviews have also been produced in Ireland (2002),<sup>11</sup> Australia (2007)<sup>12</sup> and most recently by the European Commission (2010).<sup>13</sup> Except for a dose-response relationship between water fluoride level and the prevalence of dental fluorosis, findings have generally shown fluoridation to be beneficial, and no reliable association has been found for any other adverse effects. The York review and MRC report both highlighted the need for more good-quality research.

The York review concluded that the best available evidence suggests that fluoridation of drinking water supplies reduces the prevalence of dental decay.

The same review concluded that little high quality research had been carried out on the broader question of fluoride and health, and that the available evidence did not allow confident estimates to be made of other possible risks to health.

A review by the Australian Government National Health and Medical Research Council, answering the question *"Is intentional water fluoridation more efficacious than no water fluoridation in the prevention of dental caries?"* concluded that the existing body of evidence strongly suggests that water fluoridation is beneficial in reducing dental caries.

All major reviews of the evidence, including the York and MRC reviews, found no reliable evidence to support claims that fluoridated water causes cancer, bone disease, kidney disease or birth defects. Reports suggesting harmful effects often refer to studies where the concentration of fluoride was much higher than the recommended level.

## Does the use of fluoride reduce health inequalities?

Cochrane reviews have examined the interaction between the preventive effect (measured as prevented fraction) of each type of topical fluoride and baseline levels of caries – i.e. whether each type of topical fluoride was more effective when the initial level of caries was higher.<sup>3-5,7</sup> No specific interaction was found for fluoride gels, mouthrinses or varnish. However the effect of fluoride toothpaste was found to increase as the level of caries increased, indicating that fluoride toothpaste can be effective in reducing inequalities. The York review concluded that the available evidence did not allow a conclusion to be reached on whether water fluoridation reduced dental health inequalities.

## What about dental fluorosis?

Dental fluorosis can be a possible adverse effect following ingestion of excessive topical fluoride by young children. In its mildest form, dental fluorosis presents as faint white lines and in its most severe form as brown staining or pitting of the tooth enamel. A Cochrane review looked at the relationship between topical fluorides and dental fluorosis.<sup>14</sup> Most of the available evidence focussed on mild fluorosis and there was a lack of robust evidence examining the topic. Weak evidence was found that starting the use of fluoride toothpaste in children under the age of 12 months may be associated with an increased risk of mild fluorosis

The York review<sup>9</sup> highlighted that fluoride can cause dental fluorosis and found a dose-response relationship between water fluoride level and fluorosis prevalence. The MRC report<sup>10</sup> recommended further research to ascertain prevalence and establish the public perception of fluorosis.

## Is fluoride the only measure for preventing dental decay at population level?

No. We suggest that every local area should have an oral health strategy that considers all effective methods to improve local oral health.

As well as methods of increasing the availability of fluoride - be it through fluoridated water, fluoride rinses, fluoride varnish or fluoride toothpaste - a strategy to improve oral health should include plans to incorporate healthy eating advice, identify sugar-free medicines, improve periodontal health, provide smoking cessation guidance, address alcohol misuse and prevent tooth erosion.

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