

# The Role of Fluoride in the Prevention of Tooth Decay



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## KEYWORDS

- Dental caries • Dental decay • Oral health • Fluorides • Primary prevention
- Secondary prevention • Children

## KEY POINTS

- Fluoride is the key to prevention of tooth decay.
- There are multiple fluoride modalities.
- Effectiveness and safety of fluoride depend on dose and concentration.
- Individual level fluoride use occurs at home and with professional application.
- Community level prevention occurs through fluoridation of water or salt.

## INTRODUCTION

### *Dental Caries (Tooth Decay) in Children*

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Early childhood caries (ECC) is defined as the presence of one or more decayed (non-cavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a child younger than 6 years.<sup>1</sup> For children older than 6 years, there is no special category or definition of dental caries (see separate section/chapter on Dental Caries).

### *Fluoride is the Key to Prevention of Tooth Decay*

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Fluoride works to reduce the prevalence and severity of dental caries that requires restorative dental care, in preruleptive, posteruptive, systemic, and topical situations.

There are multiple mechanisms by which fluoride works:<sup>2</sup>

- Through reducing demineralization of enamel in the presence of acids produced by cariogenic bacteria in dental plaque breaking down fermentable carbohydrates,
- Through remineralization of early enamel caries, and
- Through inhibition of bacterial activity in dental plaque.

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Fluoride accumulates in dental plaque as fluoride ions from saliva, water, toothpaste and rinses, and professionally applied dental products. During daily tooth cleaning, some dental plaque remains, which provides the reservoir of fluoride for the remineralization of the tooth surface. High-fluoride modalities, such as fluoride varnish, combine with calcium in dental plaque to form globules of calcium fluoride, which dissociate slowly in the presence of plaque acids (lactic and pyruvic acids produced by bacterial breakdown of fermentable carbohydrates); this occurs because of the presence of a phosphate or protein-rich coating of the globular deposits of calcium fluoride, which releases bioavailable fluoride ions over a longer period of time.<sup>3</sup>

In addition, progression of caries in dentin toward the pulp may be inhibited or slowed by increased fluoride concentration within dentin. Fluoride can be incorporated into the developing tooth if a child swallows fluoride toothpaste or water in communities with fluoridated water.<sup>4</sup> There are multiple fluoride modalities, from programs in the community and schools to home-based approaches and professionally applied fluoride in dental offices and other settings.

### ***Community Level Fluoride Programs***

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The world's population exceeds 7 billion, yet fewer than 1 billion have access to proven community-based water or salt fluoridation programs (and not all those with access take advantage of it). Such programs reduce the prevalence and severity of tooth decay, the most common chronic disease of children, which may be untreated in as much as 95% of the population of some countries.<sup>5</sup>

#### ***Water fluoridation***

Water fluoridation is practiced in many countries throughout the world. As of 2012, more than 420 million people worldwide have access to either naturally fluoridated water (about 50 million) or water with adjusted fluoride concentrations at or near optimal (about 370 million).<sup>6</sup> In the United States, more than 211 million people—or about 75% of the population served by public water supplies—have access to fluoridated water.<sup>7</sup> A global systematic Cochrane review has shown that the introduction of community water fluoridation results in a 35% reduction in the mean number of decayed, missing, and filled primary teeth and a 26% reduction in the mean number of decayed, missing, and filled permanent teeth in children. Water fluoridation has also increased the percentage of children with no decay by 15%, according to the global Cochrane review.<sup>8</sup> Pediatric providers should encourage families to drink tap water where it is fluoridated.

#### ***Salt fluoridation***

It has been estimated that between 40 million and 280 million people worldwide use salt fluoridation, mainly in European, South American, and Central American countries.<sup>9</sup> Salt fluoridation is sometimes suggested as an option for communities that have a low water fluoride concentration and have no possibility of implementing community water fluoridation. There are no salt fluoridation programs in the United States. The benefits and safety of salt fluoridation are similar to water fluoridation.<sup>10</sup> Although this is effective when no water fluoridation can be achieved, one has to be cautious if both options are available. It is recommended that a national fluoride program use only one of these community-based approaches (water or salt) to minimize the risk for dental fluorosis in young children with developing teeth.<sup>11</sup>

### ***School-Based Fluoride Programs***

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#### ***Fluoridated milk***

Although not practiced in the United States, fluoridated milk may be beneficial to schoolchildren, contributing to a substantial reduction in dental caries in primary

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