



Topic Summary: Fluoride and Dental Caries

By Center for Fluoride Research Analysis / Fluoride Science Editorial Board

Last updated: September 16, 2016

Available at fluoridescience.org/dental-caries

Dental caries, or tooth decay, is one of the most common chronic diseases experienced by children and adults in the United States. It is a multifactorial disease process driven by cariogenic bacteria in the mouth resulting in the dissolution of tooth structure.

Cariogenic bacteria and inadequate oral hygiene, in addition to a diet consisting of an increased amount of sugar and carbohydrates, promote the decay process ultimately leading to pulpal necrosis and acute systemic infection if proper intervention is not provided in a timely manner to reverse or halt the disease process.

The beneficial effect of fluoride in the prevention and control of dental caries was discovered as a result of extensive epidemiological studies of people living in communities with varying levels of natural fluoride in drinking water, which showed a strong inverse relationship between levels of fluoride and dental caries.^{1,2} An observed natural breakpoint between the level of fluoride associated with decreasing prevalence of dental caries and increasing prevalence of objectionable enamel fluorosis was the basis of the U.S. Public Health Service's recommendation in 1962 regarding optimal fluoride level in drinking water at the concentration of 1 mg/L (or ppm). An optimal range from 0.7 to 1.2 mg/L was recommended for the prevention and control of dental caries in the community taking account of differing levels of water consumption associated with regional air temperature.^{2,3} With fluoride in drinking water recognized as a public health measure to control dental caries, many ways of incorporating fluoride into daily use have been implemented since. The most widespread of these has been the introduction of fluoride into toothpaste, while fluoride was also made available via dental rinses, gels, foams, varnishes, tablets and drops. Although it is possible to reduce the incidence of dental caries by promoting proper oral hygiene and the avoidance of excessive intake of dietary sugars, the outcome depends on the individual's behavior and the quality of that

behavior. While many countries in Europe, Latin America, and the Caribbean have chosen to add fluoride to milk and/or table salt, the most practical and cost-effective approach to prevent dental caries at the community level in the U.S. is through fluoridation of drinking water.

On April 25, 2015, the U.S. Department of Health and Human Services announced the final recommendation for optimal fluoride level in drinking water at the concentration of 0.7 mg/L based on the contemporary landscape surrounding community water fluoridation that indicates 1) the pattern of water consumption is no longer different across different temperature zones, 2) the sources of fluoride has increased, and 3) national surveillance data show an increasing trend in the rate of mild-enamel fluorosis in recent years.⁴ This standardized level of fluoride in drinking water maintains the public health benefit of caries prevention while reducing the occurrence of enamel fluorosis. Over the past seventy years with large reductions in tooth decay in many industrialized countries which utilize water fluoridation, including the U.S., its effectiveness, safety, and return on investment of this initiative have been proven.⁵⁻⁸ The following section summarizes the findings from the most recent systematic reviews on this topic.

SYSTEMATIC REVIEWS ON FLUORIDE AND DENTAL CARIES: WATER FLUORIDATION

MCDONAGH ET AL. (2000)⁵

Twenty-six studies on the effect of water fluoridation on dental caries, published before February 2000, met the inclusion criteria. The effect of water fluoridation was systematically examined as the difference in change in the prevalence of dental caries from baseline to final observation in fluoridated areas compared with non-fluoridated areas using the following two outcome measures: 1) decayed, missing, and filled primary/permanent teeth; 2) proportion of children without dental caries. They found

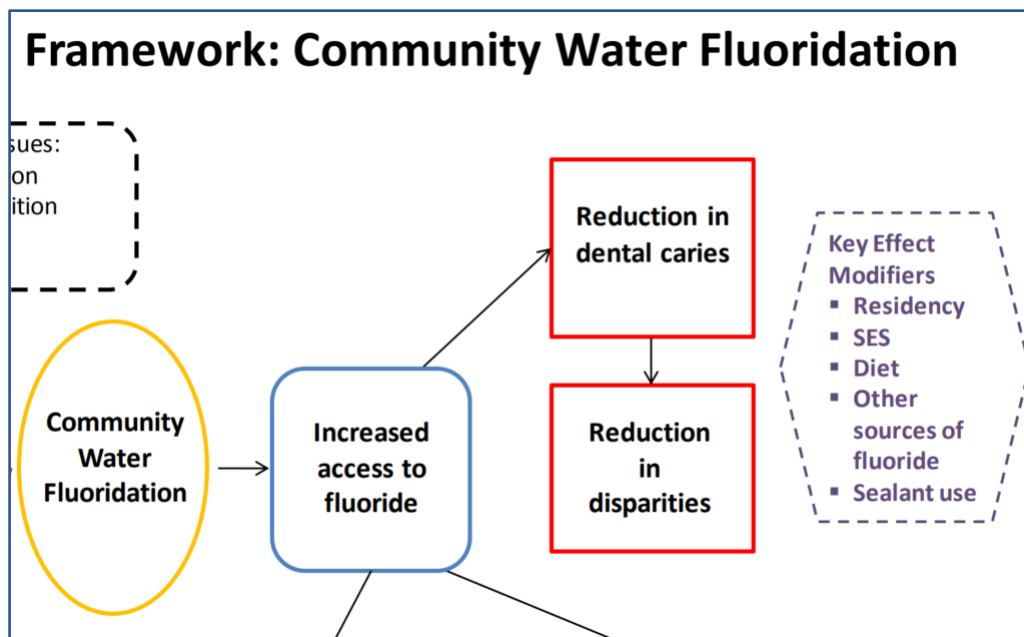
- Water fluoridation was linked to increased proportion of children without dental caries: Median difference was 14.6% (Interquartile range of 5.1 to 22.1%)
- Children living in fluoridated areas had median 2.25 fewer decayed, missing, or filled teeth (Interquartile range of 1.28-3.63) relative to children living in non-fluoridated areas.

TRUMAN ET AL. (COMMUNITY PREVENTIVE SERVICES TASK FORCE 2002)⁶

Twenty-one studies, conducted in various geographical locations around the world, including the United States, met inclusion criteria for systematic reviews of evidence on the effect of initiating or terminating community water fluoridation and its ability to reduce dental caries. The systematic review indicated:

- When measuring decay rates before and after water fluoridation, the median decrease among children 4 to 17 years was 29.1% compared to the control group.
- The decay rates that were measured after water fluoridation only, the median decrease among children 4 to 17 years was 50.7% compared to the control group.
- In communities with children representing various socioeconomic statuses, fluoridation was found to decrease tooth decay in the population.
- Community water fluoridation was found to be cost-saving (9 studies qualified for review of the economic efficiency of water fluoridation program).

UPDATED REVIEW (COMMUNITY PREVENTIVE SERVICES TASK FORCE 2013)⁷



Excerpt from the CPSTF Analytic Framework for the group’s fluoride and dental caries review

Twenty-eight studies on caries (including 2 studies published between 1999 and 2012) and 16 studies on oral health disparities (3 studies published between 1999 and 2012) were systematically examined to update the Task Force’s recommendation on caries-fluoridation. Fluoride concentrations in most of the intervention sites ranged from 0.7 to 1.2 mg/L. Combined evidence from McDonagh’s and this updated review showed:

- A median decrease of 15.2 % in caries experience following fluoride initiation (12 studies).
- Community water fluoridation reduces the prevalence of dental caries across socioeconomic groups.
- Community water fluoridation remains to be cost-saving: Larger cost-benefit ratio in larger communities due to smaller cost-per capita with larger population size

(10 studies qualified for review of the economic efficiency of water fluoridation program).

IHEOZOR-EJIOFOR ET AL. (COCHRANE REVIEW 2015)⁸

Due to the Cochrane's strict inclusion criteria for caries studies, only 20 studies on caries published before February 2015 were systematically reviewed.

- Even though most of studies reviewed were determined as being at high-risk for bias, the findings indicated that initiation of water fluoridation is effective in reducing tooth decay in children (35% and 26% reductions in overall caries experience in primary teeth and in permanent teeth, respectively).
- The review group could not draw conclusions regarding the initiation of water fluoridation and its effect on disparities in tooth decay across social class, tooth decay prevention among adults, or cessation of water fluoridation, due to insufficient evidence filtered through Cochrane's criteria.

REFERENCES

1. Dean HT. The investigation of physiological effects by the epidemiological method. In: Moulton FR, ed. Fluorine and dental health. Washington, DC: American Association for the Advancement of Science 1942. p. 23-31.
2. Burt BA, Eklund SA. Dentistry, Dental Practice, and the Community. 6th St Louis: Elsevier Saunders; 2005
3. Public Health Service. Public Health Service drinking water standards—revised 1962. Washington, DC: US Department of Health, Education, and Welfare, 1962. PHS publication no. 956.
4. US. Department of Health and Human Services Federal Panel on Community Fluoridation. U.S. Public Health Service Recommendation for Fluoride Concentration in Drinking Water for the Prevention of Dental Caries. Public Health Reports. Jul-Aug 2015. Vol.130 Available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4547570/>
5. McDonagh MS, Whiting PF, Wilson PM, Sutton AJ, Chestnut I, Cooper J et al. Systematic review of water fluoridation. Br Med J. 2000;321:855–9.
6. Truman BI, Gooch BF, Sulemana I et al. Reviews of evidence on interventions to prevent dental caries, oral and pharyngeal cancers, and sports-related craniofacial injuries. Am J Prev Med. 2002;23(1S):21-54.
7. Community Preventive Services Task Force. Preventing dental caries: Community Water Fluoridation. Available at <https://www.thecommunityguide.org/findings/dental-caries-cavities-community-water-fluoridation>
8. Iheozor-Ejiofor Z, Worthington HV, Walsh T, et al. Water fluoridation for the prevention of dental caries. Cochrane Database Syst Rev. 2015, June 18. Abstract

available
at <https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD010856.pub2/epdf/abstract>

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