

Fluoride Therapy

Latest Revision

2018

Purpose

The American Academy of Pediatric Dentistry intends these recommendations to help practitioners and parents make decisions concerning appropriate use of fluoride as part of the comprehensive oral health care for infants, children, adolescents, and persons with special health care needs.

Methods

This document was developed by the Liaison with Other Groups Committee and adopted in 1967. These recommendations by the Council of Clinical Affairs are a revision of the previous version, last revised in 2014. To update this guidance, an electronic search of the scientific literature from 2012 to 2017 regarding the use of systemic and topical fluoride was completed. Database searches were conducted using the terms: fluoride caries prevention, fluoridation, fluoride gel, fluoride varnish, fluoride toothpaste, fluoride therapy, and topical fluoride. Because 720 papers were identified through these electronic searches, an alternate strategy of limiting the information gathering to systematic review using the term fluoride caries prevention yielded 95 papers since 2012. Nine well-conducted systematic reviews¹⁻⁹ and their references primarily were used for this update. Expert opinions and clinical practices also were relied upon for these recommendations.

Background

Fluoride has been a major factor in the decline in prevalence and severity of dental caries in the U.S. and other economically developed countries. It has several caries-protective mechanisms of action. Topically, low levels of fluoride in plaque and saliva inhibit the demineralization of sound enamel and enhance the remineralization of demineralized enamel. Fluoride also inhibits dental caries by affecting the metabolic activity of cariogenic bacteria.¹⁰ High levels of fluoride, such as those attained with the use of topical gels or varnishes, produce a temporary layer of calcium fluoride-like material on the enamel surface. The fluoride is released when the pH drops in response to acid production and becomes available to remineralize enamel or affect bacterial metabolism.¹¹ The original belief was that fluoride's primary action was to inhibit dental caries when incorporated into developing dental enamel (i.e., the systemic route), but the fluoride concentration in sound enamel does not fully explain the marked reduction in dental caries. It is oversimplification

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to designate fluoride simply as systemic or topical. Fluoride that is swallowed, such as fluoridated water and dietary supplements, may contribute to a topical effect on erupted teeth (before swallowed, as well as a topical effect due to increasing salivary and gingival crevicular fluoride levels). Additionally, elevated plasma fluoride levels can treat the outer surface of fully mineralized, but unerupted, teeth topically. Similarly, topical fluoride that is swallowed may have a systemic effect.¹²

Fluoridation of community drinking water is the most equitable and cost-effective method of delivering fluoride to all members of most communities.¹³ Water fluoridation at the level of 0.7-1.2 milligrams fluoride ion per liter (i.e., parts per million fluoride [**ppm F**]) was introduced in the U.S. in the 1940s. Since fluoride from water supplies is now one of several sources of fluoride, the Department of Health and Human Services has recommended not having a fluoride range, but rather to standardize all water to the 0.7 ppm F level. The rationale is to balance the benefits of preventing dental caries while reducing the chance of fluorosis.¹

Community water fluoridation has been associated with the decline in caries prevalence in U.S. adolescents, from 90 percent in at least one permanent tooth in 12-17 years-olds in the 1960s, to 60 percent in a 1999-2004 survey.¹⁴ When used appropriately, fluoride is both safe and effective in preventing and controlling dental caries. Although adverse health effects (e.g., decreased cognitive ability, endocrine disruption and cancer) have been ascribed to the use of fluoride over the years, the preponderance of evidence from large cohort studies and systematic reviews does not support an association of such health issues and consumption of fluoridated water.¹ Regarding cognitive ability, a recent study of mothers' urinary fluoride levels and their child's intelligence quotient (**IQ**) levels suggested an association with exposure levels greater than those recommended in the U.S. for water fluoridation.¹⁵ However, a prospective study in New Zealand did not support an association between fluoridated water and IQ measurements,¹⁶ and a national sample in Sweden found no relationship between fluoride levels in water supplies and cognitive ability, non-cognitive ability, and education.¹⁷

ABBREVIATIONS

IQ: Intelligence quotient. **NaFV:** Sodium fluoride varnish. **ppm F:** parts per million fluoride. **SDF:** Silver diamine fluoride.

Table. DIETARY FLUORIDE SUPPLEMENTATION SCHEDULE

Age	<0.3 ppm F	0.3 to 0.6 ppm F	>0.6 ppm F
Birth to 6 months	0	0	0
6 mo to 3 years	0.25 mg	0	0
3 to 6 years	0.50 mg	0.25 mg	0
6 to at least 16 years	1.00 mg	0.50 mg	0

Consumption of fluoride during the mineralization of teeth, however, can cause fluorosis (children 1-3 years of age being most susceptible for fluorosis of the permanent incisors). The National Health and Nutrition Examination Survey 1999-2004 study found 23 percent of the U.S. population had very mild or mild fluorosis.¹⁸ Decisions concerning the administration of fluoride are based on the unique needs of each patient, including the risks and benefits (e.g., risk of mild or moderate fluorosis versus the benefits of decreasing caries increment and, in some cases preventing, devastating dental disease).

Fluoride supplements also are effective in reducing prevalence of dental caries and should be considered for children at high caries risk who drink fluoride-deficient (less than 0.6 ppm F) water¹⁹ (see Table). Determination of dietary fluoride before prescribing supplements can help reduce intake of excess fluoride. Sources of dietary fluoride may include drinking water from home, day care, and school; beverages such as soda²⁰, juice²¹, and infant formula²²; prepared food²³; and toothpaste. Concentrated infant formulas requiring reconstitution with water have raised concerns regarding an increased risk of fluorosis.²⁴ Infants may be particularly susceptible because of the large consumption of such liquid in the first year of life, while the body weight is relatively low.¹² An evidence-based review found that consumption of reconstituted infant formula can be associated with an increased risk of mild fluorosis, but recommended the continued use of fluoridated water.²⁵ One study has shown that dental fluorosis levels do not vary in fluoridated areas regardless of premixed versus reconstituted formula.²⁶ Standardization of the optimal fluoride levels in drinking water to 0.7 ppm F, however, makes this issue moot.

Professionally-applied topical fluoride treatments are efficacious in reducing prevalence of dental caries. The most commonly used agents for professionally-applied fluoride treatments are five percent sodium fluoride varnish ([NaFV] 2.26 percent F, 22,600 ppm F) and acidulated phosphate fluoride ([APF]; 1.23 percent F, 12,300 ppm F). Meta-analyses of 23 clinical trials, most with twice yearly application, favors the use of fluoride varnish in primary and permanent teeth.² Unit doses of fluoride varnish are the only professional topical fluoride agent that are recommended for children younger than age six.² Meta-analyses of placebo-controlled trials show that fluoride gels, applied at three months to

one year intervals, also are efficacious in reducing caries in permanent teeth.²⁷ Some topical fluoride gel and foam products are marketed with recommended treatment times of less than four minutes, but there are no clinical trials showing efficacy of shorter than four-minute application times.²⁸ There also is limited evidence that topical fluoride foams are efficacious in children.² Children at risk for caries should receive a professional fluoride treatment at least every six months.²⁸

Silver diamine fluoride ([SDF]; 5 percent F 44,800 ppm F) recently has been approved by the U.S. Food and Drug Administration and currently is used most frequently to arrest dentinal caries. SDF arrests caries by the antibacterial effect of silver and by remineralization of enamel and dentin.⁹ Some clinical trials show a caries arrest rate greater than 80 percent,⁷ but such studies have a high risk of bias and a wide variation of results, leading to conditional recommendations at this time.²⁹ Although the product is highly concentrated, less than a drop is needed to treat several caries lesions. The only reported side effects of SDF are that caries lesions stain black after treatment, and it will temporarily stain skin with contact.

Home use of fluoride products for children should focus on regimens that maximize topical contact, in lower-dose higher-frequency approaches.³⁰ Meta-analyses of more than 70 randomized or quasi-randomized controlled clinical trials show that fluoride toothpaste is efficacious in reducing prevalence of dental caries in permanent teeth, with the effect increased in children with higher baseline level of caries with higher concentration of fluoride in the toothpaste, greater frequency of use, and supervision of brushing.^{31,32} A meta-analysis of eight clinical trials on caries increment in preschool children also shows that tooth brushing with fluoridated toothpaste significantly reduces dental caries prevalence in the primary dentition.⁶ Using no more than a smear or rice-size amount of fluoridated toothpaste for children less than three years of age may decrease risk of fluorosis. Using no more than a pea-size amount of fluoridated toothpaste is appropriate for children aged three to six⁸ (see Figure). To maximize the beneficial effect of fluoride in the toothpaste, supervised tooth-brushing should be done twice a day and rinsing after brushing should be kept to a minimum or eliminated altogether.⁴ Other topical fluoride products (e.g.,

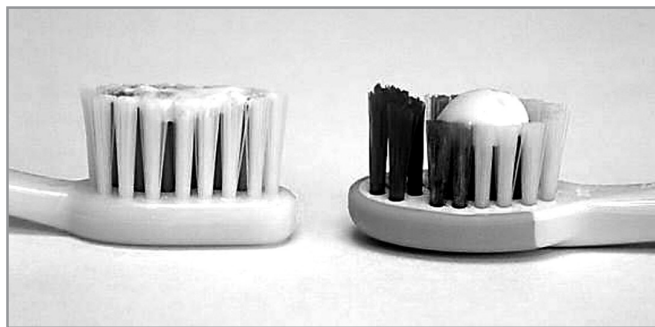


Figure. Comparison of a smear (left) with a pea-sized (right) amount of toothpaste.

prescription-strength home-use 0.5 percent fluoride gels and pastes; prescription-strength, home-use 0.09 percent fluoride mouthrinse) have benefit in reducing dental caries in children six years or older.²

Recommendations

1. There is confirmation from evidence-based reviews that fluoride use for the prevention and control of caries is both safe and highly effective in reducing dental caries prevalence.
2. There is support from evidence-based reviews that fluoride dietary supplements are effective in reducing dental caries and should be considered for children at caries risk who drink fluoride-deficient (less than 0.6 ppm) water.
3. There is support from evidenced-based reviews that professionally applied topical fluoride treatments as five percent NaFV or 1.23 percent F gel preparations are efficacious in reducing caries in children at caries risk.
4. There is support from evidence-based reviews that fluoridated toothpaste is effective in reducing dental caries in children with the effect increased in children with higher baseline level of caries, higher concentration of fluoride in the toothpaste, greater frequency in use, and supervision. Using no more than a smear or rice-size amount of fluoridated toothpaste for children less than three years of age may decrease risk of fluorosis. Using no more than a pea-size amount of fluoridated toothpaste is appropriate for children aged three to six.
5. There is support from evidenced-based reviews that prescription-strength home-use 0.5 percent fluoride gels and pastes and prescription-strength home-use 0.09 percent fluoride mouthrinse also are effective in reducing dental caries.
6. There is support from evidence-based reviews to recommend the use of 38 percent silver diamine fluoride for the arrest of cavitated caries lesions in primary teeth as part of a comprehensive caries management program.

References

1. U.S. Department of Health and Human Services Panel on Community Water Fluoridation. U.S. Public Health Services recommendation for fluoride concentration in drinking water for the prevention of dental caries. *Public Health Reports* 2015;130(5):1-14.
2. Weyant RJ, Tracy SL, Anselmo T, et al. Topical fluoride for caries prevention: Executive summary of the updated clinical recommendations and supporting systematic review. *J Amer Dent Assoc* 2013;144(11):1279-91.
3. Lenzi TL, Montagner A, Soares FLM, et al. Are topical fluorides effective for treating incipient carious lesions: A systematic review and meta-analysis. *J Am Dent Assoc* 2016;147(2):84-92.e1.

4. Scottish Intercollegiate Guideline Network, Dental interventions to prevent caries in children. March 2014. Available at: "www.sign.ac.uk/assets/sign138.pdf". Accessed October 10, 2017. (Archived by WebCite® at: "<http://www.webcitation.org/6xE7Ay0oY>")
5. Chou R, Cantor A, Zakher B, Mitchell JP, Pappas M. Prevention of Dental Caries in Children Younger Than 5 Years Old: Systematic Review to Update the U.S. Preventive Services Task Force Recommendation. Evidence Synthesis No. 104. AHRQ Publication No. 12-05170-EF-1. Rockville, Md.: Agency for Healthcare Research and Quality; 2014.
6. Santos APP, Nadanovsky P, Oliveira BH. A systematic review and meta-analysis of the effects of fluoride toothpaste on the prevention of dental caries in the primary dentition of preschool children. *Community Dent Oral Epidemiol* 2013;41(1):1-12.
7. Gao SS, Zhao IS, Hiraishi N, et al. Clinical trials of silver diamine fluoride in arresting caries among children: A systematic review. *Int Amer Assoc Dent Res* 2016;1(3):201-10.
8. Wright JT, Hanson N, Ristic H, et al. Fluoride toothpaste efficacy and safety in children younger than 6 years. *J Am Dent Assoc* 2014;145(2):182-9.
9. Zhao IS, Gao SS, Hiraishi N, et al. Mechanisms of silver diamine fluoride on arresting caries: A literature review. *Int Dent J* 2018;68(2):67-76.
10. Buzalaf MA, Pessan JP, Honório HM, ten Cate JM. Mechanism of action of fluoride for caries control. *Monogr Oral Sci* 2011;22:97-114.
11. Center for Disease Control and Prevention. Recommendations for using fluoride to prevent and control dental caries in the United States. *MMWR Recomm Rep* 2001;50(RR-14):1-42.
12. Tinanoff N. Use of fluoride. In: Berg J, Slayton RA, eds. *Early Childhood Oral Health*. 2nd ed. Hoboken, N.J.: Wiley-Blackwell; 2016:104-19.
13. Division of Oral Health, National Center for Chronic Disease Prevention and Health Promotion, Center for Disease Control and Prevention. Achievements in public health, 1900-1999; Fluoridation of drinking water to prevent dental caries. *JAMA* 2000;283(10):1283-6.
14. U.S. Department of Health and Human Services. Proposed HHS recommendation for fluoride concentration in drinking water for prevention of dental caries. *Federal register* 2011;76(9):2383-8.
15. Bashash M, Thomas D, Hu H, et al. Prenatal fluoride exposure and cognitive outcomes in children at 4 and 6–12 years of age in Mexico. *Environmental Health Perspective*, 2017. Available at: "<https://doi.org/10.1289/EHP655>". Accessed October 10, 2017. (Archived by WebCite® at: "<http://www.webcitation.org/6xE7OtaW3>")

16. Broadbent JM, Thomson WM, Ramrakha S, et al. Community water fluoridation and intelligence: Prospective study in New Zealand. *Am J Public Health* 2015;105(1):72-6.
17. Aggeborn L, Öhman M. The effects of fluoride in the drinking water. 2016. Available at: "<https://sites.google.com/site/linuzaggeborn/aggeborn-ohman-20161103.pdf?attredirects=1>". Accessed October, 10, 2017. (Archived by WebCite® at: "<http://www.webcitation.org/6xE7YwKhd>")
18. Beltrán-Aguilar ED, Barker L, Dye BA. Prevalence and severity of dental fluorosis in the United States, 1999-2004, NCHS Data Brief No. 53; 2010:1-8.
19. Rozier RG, Adair S, Graham F, et al. Evidence-based clinical recommendations on the prescription of dietary fluoride supplements for caries prevention: A report of the American Dental Association Council on Scientific Affairs. *J Am Dent Assoc* 2010;141(12):1480-9.
20. Heilman JR, Kiritsy MC, Levy SM, Wefel JS. Assessing fluoride levels of carbonated soft drinks. *J Am Dent Assoc* 1999;130(11):1593-9.
21. Kiritsy MC, Levy SM, Warren JJ, Guha-Chowdhury N, Heilman JR, Marshall T. Assessing fluoride concentrations of juices and juice-flavored drinks. *J Am Dent Assoc* 1996;127(7):895-902.
22. Levy SM, Kohout FJ, Guha-Chowdhury N, Kiritsy MC, Heilman JR, Wefel JS. Infants' fluoride intake from drinking water alone, and from water added to formula, beverages, and food. *J Dent Res* 1995;74(7):1399-407.
23. Heilman JR, Kiritsy MC, Levy SM, Wefel JS. Fluoride concentrations of infant foods. *J Am Dent Assoc* 1997; 128(7):857-63.
24. Hujoel PP, Zina LG, Moimas SAS, Cunha-Cruz J. Infant formula and enamel fluorosis. A systematic review. *J Am Dent Assoc* 2009;140(7):841-54.
25. Berg J, Gerweck C, Hujoel PP, et al. Evidence-based clinical recommendations regarding fluoride intake from reconstituted infant formula and enamel fluorosis. *J Am Dent Assoc* 2011;142(1):79-87.
26. Do LG, Levy SM, Spencer AJ. Association between infant formula feeding and dental fluorosis and caries in Australian children. *J Public Health Dent* 2012;72(2): 112-21.
27. Marinho VC, Higgin JP, Logan, S, Sheiham A. Systematic review of controlled trials on the effectiveness of fluoride gels for the prevention of dental caries in children. *J Dent Ed* 2003;67(4):448-58.
28. Hunter JW, Chan JT, Featherstone DB, et al. Professionally-applied topical fluoride: Evidence-based clinical recommendations. *J Am Dent Assoc* 2006;137(8):1151-9.
29. Crystal YO, Marghalani AA, Ureles SD, et al. Use of silver diamine fluoride for dental caries management in children and adolescents, including those with special health care needs. *Pediatr Dent* 2017;39(5):E135-E145.
30. Adair SM. Evidence-based use of fluoride in contemporary pediatric dental practice. *Pediatr Dent* 2006;28(2):133-42.
31. Marinho VC, Higgins JP, Logan S, Sheiham A. Fluoride toothpaste for preventing dental caries in children and adolescents. *Cochrane Database of Sys Rev* 2003;(1): CD002278.
32. Walsh T, Worthington HV, Glenny AM, Appelbe P, Marinho VC, Shi X. Fluoride toothpastes of different concentrations for preventing dental caries in children and adolescents. *Cochrane Database of Sys Rev* 2010; (1):CD007868.