Community Water Fluoridation

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The American Association for Dental, Oral, and Craniofacial Research (AADOCR) supports community water fluoridation as a safe, effective, and evidence-based intervention for the prevention of dental caries. Fluoride occurs naturally in water, and fluoridation is the controlled addition of fluoride to community water systems to the level recommended for caries prevention. Community water fluoridation has its origins in the 1930s when US Public Health Service dentists Drs. Henry Klein and Carroll Palmer found a substantially lower prevalence of caries among American Indian children in areas with higher levels of fluoride in their drinking water than among those in areas with very low fluoride levels[1]. That negative association between naturally occurring fluoride levels in drinking water and the prevalence and severity of dental caries was subsequently confirmed in a 1940 cross-sectional study of 7,200 white children[2]. The hypothesis that adjusting the fluoride level in drinking water could prevent dental caries was tested in community trials of four test cities and matched control cities that began in 1945[3–6]. At the end of the studies, which ranged up to 15 years, the mean number of permanent teeth among children aged 12–14 years that were decayed, missing due to caries, or filled was 48–70% lower than before fluoridation commenced [7,8] or in the non-fluoridated control cities[9,10].What began as a small trial of the controlled addition of fluoride to water in Grand Rapids, Michigan has now reached 73% of the United States population who drink from a community water system and has resulted in a significant decrease in dental caries[11,12].

Dental caries – the destruction of dental hard tissues – can result in pain, infection and tooth loss[13]. Caries is caused by acidic byproducts produced from microbial fermentation of sugar[13]. Dental caries is the most common chronic disease of childhood[14], but affects people throughout the lifespan. The prevalence of dental caries experience among U.S. youth aged 2–19 years was 46% for 2015- 2016, with 13% having untreated caries[15]. Hispanic children experienced the highest prevalence of dental caries (57%), followed by Non-Hispanic black children (48%), and Non-Hispanic white children (40%)[15]. On average, older adults can expect at least 1–2 new caries lesions per year[16]. Children with poor oral health are more likely than those with good oral health to miss school and suffer academically[17,18]. Children with dental problems are also more likely to exhibit shyness, unhappiness, feeling of worthlessness, and reduced friendliness[18,19]. Parents also often report absences from school or work to seek treatment for their children[20].

Many studies point to the effectiveness of community water fluoridation in decreasing the prevalence and severity of dental caries. A systematic review of 20 studies by Cochrane, an independent group that reviews medical research to inform evidence-based policies and health guidelines, showed that water fluoridation decreased tooth decay in both the primary and permanent teeth of children and increased the number of children free of decay in primary and permanent teeth[21, 22]. Another systematic review

by the Community Preventive Services Task Force (CPSTF), an independent panel of public health experts appointed by the Director of the Centers for Disease Control and Prevention (CDC), found that starting water fluoridation in a community decreased caries in children ages 4–17 by 30-50% and that stopping water fluoridation increased caries by 18%[23, 24]. Furthermore, reducing childhood caries experience and severity may have benefits into adulthood by halting disease progression that can result in adult tooth loss[25, 26].

Community water fluoridation is a cost-effective method of delivering caries prevention to a large population. A systematic review by the CPSTF compared the cost of fluoridation to the money saved on dental restorations in communities that drink from fluoridated water sources[27]. CPSTF found that water fluoridation is cost- saving. In other words, the savings from fewer dental restorations are greater than the cost of fluoridation for communities of greater than 1,000 people, and the larger the community, the greater the cost savings[27]. Analyses in 2016 and 2018 confirmed this finding[26, 29].

Community water fluoridation also reduces oral health disparities. Children and adults from socioeconomically disadvantaged backgrounds are more likely than more affluent persons to suffer from dental caries and are less likely to be treated for the disease[30, 31]. When added to drinking water, fluoride can be delivered to community residents regardless of socioeconomic status or ability to access dental services. Some studies have shown decreased inequalities in caries in communities that drink from a fluoridated community water source, revealing that children of a lower socioeconomic status who have access to a fluoridated water source have less severe tooth decay and require less expensive care than children of lower socioeconomic status who do not drink fluoridated water[32]. More research is needed to determine the circumstances in which water fluoridation reduces disparities, as not all fluoridated communities show reduced disparities[21, 33].

Community water fluoridation is a safe method of delivering fluoride on a population level[34]. There have been numerous systematic reviews on claims of the potential adverse health effects of water fluoridation. None has concluded that there is a significant or consistent association between water fluoridation and the outcomes examined, including neurologic conditions, cancer, and osteoporosis[35–39]. A recent meta-analysis, examining the association between water fluoride levels up to 1.5 mg/L (milligrams of fluoride per liter of water, just over twice the recommended optimal level in the U.S.) and children's intelligence, showed that fluoride exposures relevant to community water fluoridation levels recommended in the U.S. are not associated with lower IQ scores in children[40]. Added to this, the National Toxicology Program (NTP) monograph, although not designed to evaluate the health effects of fluoridated drinking water alone, concluded that more studies are needed to fully understand the potential for lower fluoride exposure to affect children's IQ[41]. Dental fluorosis resulting in tooth discoloration is the only known adverse health effect of water fluoridation[42]. Teeth are only at risk of developing fluorosis until about age 8 during enamel formation. In the United States, dental fluorosis is mostly mild and generally does not affect the tooth

beyond esthetics[43]. Moderate and severe forms of dental fluorosis are rare[43]. The United States Public Health Service recommends a concentration of 0.7 mg/L to achieve substantial caries prevention while balancing the risk of dental fluorosis[44].

Community water fluoridation is supported by many important health and public health organizations, including the American Association of Public Health Dentistry, the American Public Health Association, the American Dental Association, the American Academy of Pediatrics, and the World Health Organization, among others. Additionally, in 1999, the CDC identified community water fluoridation as one of 10 great public health achievements of the 20th century because of its effectiveness and ability to distribute fluoride equitably and cost-effectively[45]. Information about the fluoride concentration of U.S. communities participating in water fluoridation can be found on the CDC website “My Water’s Fluoride”[46].

AADOCR always welcomes research on water fluoridation safety and effectiveness. Based on the best available evidence at this time, community water fluoridation is safe, effective for caries prevention, and cost-saving. In some communities, community water fluoridation reduces oral health disparities. Therefore, AADOCR supports community water fluoridation and recommends the fluoridation of community water sources to a level of 0.7 milligrams of fluoride per liter of water[44].

Author Contributions

R. Moffat contributed to design, data acquisition, analysis, and interpretation, drafted and critically revised the manuscript, all members of the AADOCR Science Information Committee sub-committee, contributed to conception and design, critically revised the manuscript. E. Bell, K. Rwizi, and M.K.S. Charles-Ayinde contributed to conception, design, and interpretation of the manuscript; C. Fox contributed to the conception and critically revised the manuscript. All authors gave final approval and agreed to be accountable for all aspects of the work.

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