Safety and Efficacy of Water Fluoridation

Linda L.Nix, MPH student

Walden University

PH 6165-2

Instructor: Rebecca Heick

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To the general public: Is your fluoridated water supply safe to drink and is it effective in preventing tooth decay? In an effort to be fair and balanced when googling water fluoridation on the internet, we receive some interesting controversy on the topic of sodium fluoride in our public water supply. When entering the words "fluoride" and "water" for a scholarly library search in CINAHL we get forty-eight references and more are pro-fluoridation than con-fluoridation but most of the articles bring in references from the opposing view. Newspapers and magazines have educated us about the benefits of fluoride in preventing cavities; however, rarely do we read of the dangers of fluoridated water.

Fluoridation of drinking water is hailed as one of public health's greatest achievements in the twentieth century (MMWR, 1999). Fluoride in the correct doses improves tooth enamel strength and mineralization, thereby decreasing the harmful effects of acid and bacteria in the mouth posing damage to teeth (Palmer, 2002). Fluoridation is documented to provide a cost efficient method to reach communities regardless of the person's age, wealth, social status, job or position (MMWR, 2001). All persons in the public water system gain the benefits of fluoride (Palmer, 2002). Water fluoridation generally reduces tooth decay conservatively by twenty percent (Palmer, 2002).

Fluorides are also considered to have harmful effects. Fluoride is listed on the Agency for Toxic Substances and Disease Registry (ATSDR) as a toxic chemical

(ATSDR, 2007, (S1)). Fluoridation agents used for public drinking water vary. Some water utilities use sodium fluoride, some use fluorosilicic acid, and some use sodium silicofluoride (ATSDR, 2007, (S5)). Some advocates who oppose water fluoridation indicate silicofluorides aid in the transport of lead into the bloodstream of children (Palmer, 2002). The most known risk of fluoride is dental fluorosis, an esthetic mineral dental stain on teeth produced during the development of permanent tooth enamel in the infant and preschool years. Other rarer adverse fluoride exposure problems are skeletal fluorosis, a joint and bone problem, osteosarcoma, a bone cancer, neurotoxicity of the pineal gland (Palmer, 2002) and thyroid dysfunction (Shaw, 2008).

This commentary's purpose is to address the safety and efficacy of fluoridated water for the general public. Many reputable health organizations support public water fluoridation, including the American Dental Association, Dentistry 2000, Association of Clinicians for the Underserved, and WHO. Palmer emphasizes that over one hundred national and international organizations affirm water fluoridation as one of the most cost effective ways to reduce dental decay. John Stamm, DDS spokesperson for the American Dental Association (ADA) says that dental decay is reduced with fluoridated water use, using a statistically conservative quote of twenty percent. This data is scientifically supported by research from the National Institutes of Health (NIH) (Palmer, 2002). Surgeon General David Satcher, in his Oral Health Report of 2000, stated the U.S. Preventive Services Task Force and the Canadian Task Force both have

done systematic reviews of literature before making a recommendation on the evidence of the effectiveness and efficacy of community water fluoridation programs (SGROH, 2000). Fluoride is an element that has been found to aid in the pre-eruptive phase of oral enamel development that gives teeth strength to inhibit demineralization of tooth enamel and in the post-eruption phase fluoride enhances re-mineralization of enamel and inhibits the harmful effects of bacterial and acid plaque damage to teeth (SGROH, 2000). The American Dental Association (ADA) and the World Health Organization (WHO) both emphasize that fluoride is the key agent in reducing dental caries by: (1) enabling re-mineralization of early dental decay from sugar produced acid and bacterial plaques; (2) by improving the chemical structure of enamel, thereby making it more resistant to acid breakdown; and (3) by reducing the ability of bacterial plaque to produce acids (Jones, S. et al., 2005 p.671; Featherstone, J., 1999). Although this may be true, William Hirzy, PhD, says the use of hydrofluorosilicic acid as a low-cost fluoride agent aids in the transport of lead into the bloodstream of children who may have ingested lead from the environment (Palmer, 2002). The National Institute of Environmental Health Sciences (2006) reports they led a project to compare the studies performed in 1999-2000 in New York and Massachusetts on silicofluoride water causing elevated blood lead levels in children who use silicofluoride water with another separate study involving fifty-two million children. The 2006 report found no difference in blood lead levels of the fifty-two million children studied using water

fluoridated areas to blood levels of children outside of water silicofluoride areas. It is said confounding bias, a common confounder in disease studies, accounts for the discrepancies of the results in the earlier reports. The investigators do acknowledge that analyses have limitations and more studies should be done to account for differences in housing and possible lead pipe use. Studies could also use animal toxicology and include chemical investigation to determine if lead pipes in use with fluoridated water could cause lead toxicity. The researchers, however, do not recommend discontinuation of water fluoridation until causal effect in scientific research proves fluoridation a health hazard (NIEHS, 2006).

The proper level of fluoride helps prevent dental caries. The U.S Environmental Protection Agency (EPA) places the maximum contaminate level of fluoride for dental fluorosis at 2 part per million (ppm) and for skeletal fluorosis at 4 ppm (Sidhu & Kimmer, 2002). The lower levels of fluoride additives to public drinking water are recommended at concentrations of 0.7 to 1.2 mg/L. The concentration range from 0.7 ppm to 1.2 ppm allows for maximizing the benefits of preventing dental caries while preventing dental fluorosis depending on the temperature of the air (MMWR, 2001). Areas in the country such as Colorado and Arizona where fluoride levels are high do not need to fluoridate their water; they have to filter fluoride out of their water to bring it to usable levels. The adverse affects of over exposure to fluoride are dental fluorosis (discoloration of enamel), skeletal fluorosis (abnormal bony projections), osteosarcoma

(bone cancer), neurotoxicity and thyroid dysfunction (Sidhu & Kimmer, 2002; Palmer, 2002; Limeback, 2009). Dental fluorosis leaves either light or dark spots on teeth which is esthetic in nature. Skeletal fluorosis is rare in America but is not uncommon in India, Asia and Africa. There are high levels of fluoride in the ground water and a lack of defluoridation plants in the affected areas (Reddy, 2009). The ATSDR reports that low levels of fluoride benefit teeth enamel and osteoporosis, but high levels of fluoride can cause darkening of enamel and bone fractures plus skeletal fluorosis. The ATSDR report "Relevance to Public Health" indicates that the many studies on fluoride and bone fractures are mixed and inconsistent without a consistent pattern to reported fluoride amounts justifying similar results for bone fractures. From the existing studies of fluorides in drinking water, no relationship can be found establishing a role of fluoride in preventing or causing bone fractures.

Animal studies in male rats have indicated some possible reproductive involvement at high doses of fluoride: alterations in hormone levels, histology of testes and spermatogenesis, but two-generation studies revealed no such effect. There are not enough human studies and, with the conflicting animal studies, there is a lack of evidence to suggest that high fluoride exposure causes reproductive problems (ATSDR, 2007c). The ATSDR report reads that human studies of fluoride effects on the IQ of children failed to control for confounding variables. The ATSDR report also concludes that numerous community studies on fluoride's association with cancer have indicated

water fluoridation does not increase risk of developing cancer (ATSDR, 2007c). The Department of Health and Human Services 1991 report reveals that of the data currently available there is no conclusive evidence of fluoridation causing cancer (CCEHRP, 1991).

The Environmental Health Policy Committee has done extensive review of the literature on fluoride studies and reported on the findings in 1991. In this review, conclusions indicate that drinking fluoridated water has brought reduction of dental caries to the American public in areas where fluoridation exists. Since the introduction of fluoridation of public water in the early twentieth century, newer methods of fluoridation have been developed with the topical application of fluoride products such as fluoride toothpastes and fluoride mouth rinses. However, not everyone uses these products. Differences in ethnic and social customs limit some people and groups from using these products. Studies available on the effects of fluoride and cancer prevalence fail to give evidence of fluoride being a causative contributor of increased cancer rates. The report concludes that there has been a slight increase in dental fluorosis in areas that do not have fluoridated water and therefore prudence must be used in not overusing fluoride products. No correlation has been established in fluoride effects on bone fractures and in reducing osteoporosis and further studies in these areas are needed. Skeletal fluorosis is not a problem in the United States, with only five cases cited in thirty years. However, crippling skeletal fluorosis exists in some areas of the

world due to extended high levels of fluoride exposure. Genotoxicity studies of fluoride on humans and animals continue to show no conclusive results of association. Fluoride exposure to mothers shows no evidence of fetal deformities. Low fluoride has not been found to cause problems to organs in our bodies (CCEHRP, 1991).

Given the current data and research on fluoridation of water, it can be concluded that presently with the available knowledge base that fluoridation of public water is a safe and cost-effective method of reducing dental caries. However, because the Public Health Service report is from eighteen years ago it warrants a new review of the literature and scientific studies to determine if any new data exists that would alter the public and professional organizations viewpoint on the safety and efficacy of water fluoridation. Additional research is still needed in the area of human and animal studies to determine if fluoride could have detrimental effects on the health of humans such as increasing the risk of cancer, mutations of genes and increasing the risk of bone fractures.

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