

Benefits and Risks of Water Fluoridation

An Update of the 1996 Federal-Provincial Sub-committee Report

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Executive Summary

This report provides an update of the 1996 Federal-Provincial Subcommittee Report concerning fluoride in the water supply. It consists of a review of the literature published between 1994 and 1999 concerning the benefits and health risks associated with drinking water that has been fluoridated to "optimum levels". The report is then limited by the relatively narrow scope of the review as requested by the Public Health Branch, Ontario Ministry of Health and the First Nations and Inuit Health Branch, Health Canada.

Mechanisms of action of fluoride in reducing dental caries

Although it was initially thought that the main mode of action of fluoride was through its incorporation into enamel, thereby reducing the solubility of the enamel, this pre-eruptive effect is likely to be minor. The evidence for a post-eruptive effect, particularly its role in inhibiting demineralization and promoting remineralization, is much stronger.

Reductions in dental caries

Although current studies of the effectiveness of water fluoridation have design weaknesses and methodological flaws, the balance of evidence suggests that rates of dental decay are lower in fluoridated than non-fluoridated communities. The magnitude of the effect is not large in absolute terms, is often not statistically significant and may not be of clinical significance. The effect tends to be more pronounced in the deciduous dentition. The effect tends to be maximized among children from the lower socioeconomic groups so that this section of the population may be the prime beneficiary. Canadian studies do not provide systematic evidence that water fluoridation is effective in reducing decay in contemporary child populations. The few studies of communities where fluoridation has been withdrawn do not suggest significant increases in dental caries as a result. More research is needed to document the benefits of fluoridation to adult and elderly populations in terms of reductions in coronal and root decay. Research is also needed to document improvements in the oral health-related quality of life that accrue to populations exposed to fluoridated water in order to enhance the credibility of this public health initiative.

Osteoporosis

Research on the contribution of fluoride to the treatment of osteoporosis in terms of reductions in osteoporotic fractures has produced inconsistent findings. This may be due to differences in the action of fluoride in different parts of the skeleton and/or to limitations in research designs.

Acute toxicity

Fluoride is a poison in large doses but toxic levels cannot be achieved by drinking fluoridated water. Fluoride products such as toothpaste should be kept out of the reach of children since toxic amounts could be ingested via these sources.

Dental fluorosis

Current studies support the view that dental fluorosis has increased in both fluoridated and non-fluoridated communities. North American studies suggest rates of 20 to 75% in the former and 12 to 45% in the latter. Although largely confined to the "very mild" and "mild" categories of the condition, they are of concern insofar as they are discernable to the lay population and may impact on those so affected. Although about half the fluorosis in contemporary child populations living in fluoridated communities can be attributed to fluoride from discretionary sources, efforts to reduce exposure to these sources may not be successful. Research is needed into the relative effects of dental decay and fluorosis on quality of life outcomes and community values regarding the balance between reductions in dental decay and increases in dental fluorosis associated with water fluoridation.

Bone health

Fluoride is incorporated into bone and may affect its biomechanical properties. Skeletal fluorosis is a crippling disease associated with chronic exposures of ≥ 10 mg of fluoride per day for at least ten years. Studies of bone mineral density have not detected changes consistent with the clinical picture of skeletal fluorosis from water containing levels of fluoride optimal for the reduction of dental decay.

Bone fractures

Studies of the association between water fluoridation and bone fracture are largely ecological in design. Of 11 studies published prior to 1994, two showed a protective effect, five showed no association and four suggested an increase in hip fracture rates. In the latter, the strength of the association was weak, with relative risks ranging from 1.1 to 1.4. Of four studies published between 1994 and 1999, one showed a non-significant protective effect, two showed no association and one suggested an increased risk (RR=1.3-1.4). The public health significance of small increases in hip fracture rates in elderly populations means that more studies with better research designs are needed.

Cancer

The few studies published during the review period do not challenge earlier research showing that there is no reason to believe that exposure to fluoridated water increases the risk of cancer in bones or other body tissues. While an ecological study did suggest an association with uterine cancer, the limitations of this kind of study in terms of linking exposures and outcomes in individuals, mean that it does not contradict the evidence derived from more systematic and scientifically credible case-control studies.

Child development

Recent studies emanating from China have claimed that children exposed to high levels of fluoride have lower IQ's than children exposed to low levels. The two studies claiming such an effect are deeply flawed and provide no credible evidence that fluoride obtained from water or industrial pollution affects the intellectual development of children.

Recommended and actual intakes of fluoride in Canada

Given the lack of adequate contemporary data, recommendations regarding optimal daily intakes of fluoride were based on dose-response data published in the 1940's. Optimal intakes are those derived from water fluoridated at 0.8 to 1.2 ppm, assuming no other

sources of fluoride except food. Maximum intakes were based on consumption of water at 1.6 ppm, the level before moderate fluorosis appears. Actual total daily intakes were derived from amounts present in water, food, breast milk, air, soil and toothpaste. In Canada, actual intakes are larger than recommended intakes for formula-fed infants and those living in fluoridated communities. Efforts are required to reduce intakes among the most vulnerable age group, children aged 7 months to 4 years. Children of this age who are consuming the maximum dose are at risk of moderate levels of dental fluorosis and are consuming amounts only 20% less than that at which skeletal fluorosis is possible if maintained over long periods.

Optimal levels of fluoride in the water supply

Standards regarding optimal levels of fluoride in the water supply were developed on the basis of epidemiological data collected more than fifty years ago. The optimal level of 1.0 ppm was chosen, largely on an arbitrary basis, to achieve the maximum reduction in dental caries and the minimum prevalence of fluorosis. Re-examination of the early dose response data suggests that levels as low as 0.6 ppm would have achieved approximately the same reduction in the prevalence of dental decay. There is a lack of contemporary data on dose-response relationships between fluoride concentrations in the water supply, dental caries and dental fluorosis. Nevertheless, it has been suggested that new and more flexible guidelines are needed which take into account the changing prevalence of dental caries, access to other sources of fluoride and contemporary concerns with the cosmetic effects of fluorosis. Levels as low as 0.5 ppm may be optimal in some communities. Dental fluorosis has not been viewed as a public health problem in the past but may become so in the future.

Maximum allowable concentration

A maximum allowable concentration (MAC) for Canadian drinking water of 1.5 mg/L was established in 1978. The 1996 report recommended that this level be maintained. Since drinking water is not the only source of fluoride to which children are exposed, efforts to reduce exposure to other sources of fluoride are needed in those communities in which fluoride in the drinking water approaches this concentration.