

POSITION PAPER #2A WATER FLUORIDATION

Sponsored by: Board of Directors, CPHA.

1.0 Definition

Water fluoridation is the treatment of public water supplies with selected fluoride-containing compounds for the purpose of adjusting the concentration of free fluoride ion to a level sufficient to reduce dental caries. The Advisory Committee of the Canadian Public Health Association has reviewed the relevant scientific, technical and medical literature and has recommended that in Canada the optimum concentration of fluoride be 1.2 mg/L or 1.2 parts per million of water.¹

2.0 Reason for a Position Paper

2.1 The Association's previous position on fluoridation.

The Canadian Public Health Association is on record as recommending:

"... the fluoridation of community water supplies for the reduction of dental caries in those communities where there is at present an insufficient fluoride content for this purpose, and where the procedure can be adequately controlled and supervised."

This resolution, passed in Winnipeg in 1952, has been reaffirmed periodically by similar resolutions from 1953 to 1977.²

2.2 Decline in the number of new fluoridation programs.

At the time of CPHA's first resolution in mid-1952, only two communities in Canada, Brantford and Thorold, Ontario were fluoridating their water supplies.³ A decade later, 10 percent of Canada's population were drinking fluoridated water and over the next decade, 1962-72, this proportion had increased dramatically to 35 percent. By 1980, however, only an additional 2 percent of the population to a total of 8.86 million people were receiving water in which the fluoride concentration was adjusted.⁴ Thus, the impetus for municipalities to implement fluoridation has waned since the early 1970's.

3.0 Burden of Dental Caries

3.1 Canadian dental caries prevalence levels.

Dental caries or tooth decay occurs almost universally in the population of the developed countries and to a lesser but increasing extent in the underdeveloped countries.⁵ In Canadian provinces where dental health surveys have been conducted, the results show that over one-half of all 5-year-old children have experienced dental caries in one or more primary teeth. By 13 years of age more than 90 percent of children have caries-affected teeth.^{6,7,8}

The lowest rates of dental decay were found in an Ontario survey where the average 13-14 year-old had 4.3 permanent teeth decayed, missing or filled (DMFT)⁹ and the highest were found in Quebec where the average 13-14 year-old child had experienced 9.0 DMFT.¹⁰ A similar dental survey in Alberta showed that the average 13-14 year-old child residing in metropolitan, urban and rural communities experienced 4.9 DMF teeth.¹¹ The most recent dental health survey conducted in the Atlantic Provinces found that average caries prevalence among 13-14 year-old children ranged from 5.0 to 6.0 DMFT depending on the province.¹²

3.2 Decline in the prevalence of dental caries in Canada and other countries.

A decline in dental caries prevalence has been reported in two Ontario studies, an Australian retrospective dental health study and a nation-wide children's dental health survey in the United States.^{13,14,15,16} Moreover in 1982, epidemiologists from the United Kingdom, Scandinavia, New Zealand and the United States reported that, over the period 1970 to 1980, the prevalence of dental caries had decreased 30 to 50 percent in their respective countries.¹⁷

No study is available to pinpoint the cause of the caries decline. However, the improved health status is coincident with the spread of fluoridation, the nearly universal use of fluoride dentifrice and the increased availability of preventive dental services. Most dental epidemiologists attribute the gain in health to the increased use of all types of fluorides.^{17,18}

3.3 International comparisons.

Canadian rates continue to be relatively high when compared to an estimated 3.4 DMFT for 13 year-olds in the United States and much higher than the value of 2.8 DMFT estimated for the southern United States¹⁶ and the 1975 value of 3.4 DMFT for 13 year-olds observed in Toronto.¹³ Clearly, the early occurrence and universal distribution of dental caries in the Canadian population should be considered a public health problem.

4.0 Economic Costs Resulting from Dental Caries

Costs for dentists' services of all types amounted to \$1,482.9 million in 1981 or \$61.56 per capita.¹⁹ This represents 6.7 percent of all health expenditures and about 0.44 percent of the Gross National Product in that year. To estimate the cost of treating children's decayed teeth one is compelled to use the information from provinces with children's dental programs. In Saskatchewan, for example, the program in 1980-81 covered children aged 4-14 years and cost \$10.4 million or \$77.40 per enrolled child.²⁰ This represents 19 percent of that province's total expenditures on dentists' care in 1981.

No evidence can be found to estimate the costs of treating primary dental caries in adults and senior citizens, although it is known that caries do occur on the exposed roots of teeth of older citizens.

Further evidence of the economic costs of dental caries can be obtained from a 1976 study of North Carolina dentists where it was found that only 1.7 percent of time was spent on services specifically for the treatment of periodontal disease and malocclusion.²¹

The ongoing need for retreatment was documented by a Canadian study which showed that dentists in British Columbia removed each day, on average, 3.8 old fillings replacing them with new and larger ones.²² Dental decay was given as the reason for the replacement in 68 percent of the cases. Thus, an overwhelming amount of dentists' time is spent on examining for, trying to prevent, treating and retreating dental caries.

5.0 Evidence Supporting the Efficacy and Safety of Fluoridation

5.1 Documented benefits of fluoridation.

The discovery of fluoridation as a means of reducing caries remains one of the classic studies of the epidemiology of non-communicable diseases. Original studies by American investigators documented an environmental factor (fluoride) in water that showed increasing effectiveness in reducing caries as the concentration reached 1.0 parts per million (ppm). When community trials were undertaken, including the Brantford-Sarnia-Stratford study, children in the communities that had the fluoride concentration of their water supplies adjusted to 1.0 ppm showed between 48.4 percent and 70.1 percent reductions in DMF teeth per child.²³

Adults living in communities with sufficient fluoride in the water have been shown to have fewer DMFT per person and to have lost fewer teeth than adults who have not had lifetime exposure to fluoride. Canadian investigators have also reported on a study in which lifelong consumption of fluoridated water significantly reduced the prevalence of root surface caries.²⁴

In 1977, Health Services Directorate, National Health and Welfare convened a Working Group on Preventive Dental Services with part of its mandate, "To determine through literature review, the effectiveness and efficiency of selective preventive dental services, including all aspects of dental health education and promotion". The Working Group reviewed about 200 scientific papers on the dental benefits and safety of fluoride ingestion and related fluoride therapy. The Working Group's major recommendation was that "Community water fluoridation, the most effective and efficient caries preventive measure, should continue to form a basis of dental public health policy in Canada".²⁵

An American investigator has also reviewed and analyzed studies conducted in Canada, Australia, New Zealand, United Kingdom, the Netherlands and in the German Democratic Republic.²⁶ Caries reductions were reported to be in the 45-60 percent range. The World Health Organization has reported similar findings from studies conducted in South America, Japan and Europe.^{27,28}

Recently a study of different community preventive programs was conducted by the Rand Corporation and for the American Fund for Dental Health²⁹ in five fluoridated and five non-fluoridated communities in the United States. The study's find-

ings "... reaffirm the enormous importance of fluoridation in the decay in children". The study's most effective regimen saved approximately two surfaces of decay over four years but cost \$55 per child per year. By comparison, untreated children from fluoridated communities, when compared to those in non-fluoridated communities, had one fewer surface decayed over the four years but at a total cost of less than \$1 per child per year.

5.2 Safety of water fluoridation.

As documented in the CPHA's Criteria Document in Support of a Drinking Water Standard for Fluoride,¹ fluorides are one of the most studied and best understood of naturally occurring compounds. The chemistry and physical properties of fluorides, their environmental occurrence, absorption and metabolism and relationship to human health are well documented. The summary states, in part:

"The effect of fluoride in drinking water on a number of organs has been investigated. Fluoride does not produce renal disease or renal calculi. There is, however, conflicting evidence regarding the role of fluoride in water on the progression of renal osteodystrophy in patients on long-term hemodialysis; thus the use of deionized water for this purpose may be prudent. No effect on cardiovascular morbidity has been observed, but there is limited and unconfirmed evidence of a beneficial effect in preventing calcification of the aorta. The function and size of the thyroid gland are not affected by fluoride, and there is no specific toxicity of fluoride for the thyroid gland. Hearing, vision, and the incidence of Down's syndrome births are not affected by fluoride in drinking water. Furthermore, there is no acceptable evidence of any allergy or intolerance to fluoride as found in community water supplies."

"There does not appear to be any acceptable evidence that fluoride in drinking water is carcinogenic to humans; claims that it is were based on studies in which there were deficiencies to both data handling and statistical analysis.

Fluoride is mutagenic in some organisms, the mode of action possibly being related to inhibition of DNA synthesis. The variable results with respect to effective doses and species sensitivity make extrapolation to humans difficult and point to the need for further research."

As further evidence, a 1977 study conducted for National Health and Welfare, Canada failed to confirm an association between fluoride and cancer mortality.³⁰ Similar conclusions have been reached in other reviews.^{31,32} For example, the Report of the Committee of Inquiry into the Fluoridation of Victorian Water Supplies for 1979-80³³ states:

"Assertions that fluoridation of water supplies at recommended levels of toxic, carcinogenic, mutagenic teratogenic or allergenic effect on humans are not supported by sound scientific evidence. Whilst a null proposition can never be proved, there is massive evidence to show that fluoridation at recommended levels has no harmful effect on the health of the community."

The most sensitive indicator of chronic fluoride toxicity occurs as mottled dental enamel. While mild dental mottling does occur among 10 to 12 percent of the population exposed to water containing 0.8 to 1.2 mg/L of fluoride ion, this is not unsightly and may be aesthetically pleasing.²³ Consuming water with concentrations of fluoride between 1.5 to 2.5 mg/L does produce disfigured enamel among the 40 to 50 percent of people affected. On balance, it is clear that fluoridation at the recommended levels causes no harm and does much good.

5.3 Contribution of fluoridation to current dental health levels.

What is the contribution of fluoridation to present caries levels? Given the use of fluoride dentifrices, fluoride supplements, school-based rinse programs and topical fluorides in clinical dental practice, the contribution of water fluoridation might not be expected to equal the 50 to 70 percent reductions obtained over 25 years ago. Nevertheless, the high levels of dental caries in Quebec, cited previously, relate well to that province's low, 12.3 percent of population,³ level of fluoridation.

In the 1976 Manitoba survey a history of nearly continuous exposure to fluoridated water resulted in reductions of only 14.0 to 37.5 percent when compared to those who had less exposure or no exposure to fluoridation.³⁴

The Rand²⁹ study shows that the benefits of water fluoridation continue since children in all of the communities with fluoridated water had lower age specific caries scores.

6.0 Cost Effectiveness of Fluoridation

6.1 Costs.

Recent (1981) costs for five cities in the United States and one in England range from \$0.05 U.S. to \$0.08 U.S. per capita, including capital cost allowance.²³ These costs vary according to the number of treatment points and type of equipment required, the population size and the price of the fluoride compound used. An examination of 1980 costs in Ontario showed they ranged from \$0.11 Can. to \$0.45 Can. per person per year for the fluoride compound.³⁵

Capital costs depend on the number of sites at which fluoridation takes place and the type of equipment needed. Equipment costs at six municipalities are reported to vary from \$130,000 U.S. for 5 injection points to \$1,550 for 1 injection point.²³

6.2 Benefits.

Dollar benefits accrue in the form of avoidance of expenses both to treat dental decay and perhaps in the future, for less frequent examinations and diagnostic radiographs. In looking at the former, researchers have estimated that two tooth surfaces per person per year were spared decay.³⁶ In New Zealand, water fluoridation has permitted 450 school dental nurses to provide treatment for the number of children that formerly required 690 dental nurses.²³

6.3 Cost benefit ratios.

Cost benefit ratios for water fluoridation are estimated to range from 1:2.01³⁷ to 1:2.5³⁸ to 1:50.³⁹ Thus, a conservative estimate is that one dollar spent on water fluoridation would save \$4.00 to \$5.00 in treatment costs. No benefit is included in these calculations for adults or for savings in pain or psychological costs to children.

6.4 Relative cost benefits.

It appears that for sufficiently large populations with existing piped water supplies, fluoridation has a more favourable cost benefit ratio than alternate methods of providing fluoride. Newbrun³⁹ has compared the ratio for fluoridation (1:50) to that of school water fluoridation (1:5.3) and fluoride tablets (1:17.5). Gish⁴⁰ has calculated that fluoridation has the greatest impact on the number of cavities for a fixed \$100,000 spent in various fluoride programs or in providing treatment. These findings are reinforced by the preliminary results from the Rand²⁸ study.

7.0 Human Rights and Fluoridation

In late 1983,⁴¹ two academics in the field of public health law advanced the argument that despite the benefits of fluoridation "... the following challenges must be considered: 1) At the present time no legislation in Canada forces individuals to take actions which will improve their health or to prevent non-communicable disease."

This issue has been addressed previously by the Ontario Royal Commission⁴² which concluded:

"We hold the firm opinion that the fluoridation of municipal water supplies by the authority of appropriate legislation would not be a denial of any fundamental or basic civil right or liberty which the Legislature of Ontario should protect and preserve."

8.0 Current Status of Fluoridation in Canada and the World

Worldwide, it is estimated that approximately 300 million people consume optimally fluoridated water. About 100 million people in the United States consume water containing fluorides, 30 million people in the Soviet Union and approximately 10 million people in each of three countries — Brazil, Columbia and Australia — benefit from fluoridated water.¹¹ Of the 1976 population it is estimated that 8.86 million Canadians had access to fluoridated water, this number being about 37 percent of the total population.

The three provinces with the highest proportion of the total population having access to fluoridated water are Manitoba, Ontario and Alberta with 65, 62 and 44 percent, respectively. Provinces with the lowest proportion of population on fluoridated water are British Columbia and Newfoundland with approximately 12 and 10 percent, respectively. When the proportion of the population on piped water systems — which are potentially able to be fluoridated — is considered, Nova Scotia ranks third.⁴ Sixty percent of the people in Canada who consume fluoridated water are residents of Ontario.

9.0 Conclusion

Major health organizations throughout the world support the controlled fluoridation of community water supplies. As an example, the resolution adopted on May 24, 1978 by the Thirty-first World Health Assembly states:

"The Assembly recognizing that safe, inexpensive and effective methods of prevention of dental caries exist, especially by the optimal adjustment of the fluoride content of public water supplies for which there is widespread experience, but also by other systemic and topical uses of fluorides, as well as other preventive agents or procedures:

1. Urges Member States to consider, within national plans for the prevention and control of oral disease, the fluoridation of public water supplies, where and when appropriate;
2. Believes that, where fluoridation of public drinking-water supplies is not feasible for technical or other reasons, alternative methods of achieving an optimum daily intake or application of fluoride be considered."

This review of literature as recent as 1983, finds ample evidence that the Canadian Public Health Association should continue to endorse water fluoridation as an effective, efficient and safe public health measure which reduces dental caries.

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