Thirty years of fluoridation: a review

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ABSTRACT  Fluoride contributes to stability of both teeth and bones and to reduction of caries, especially if ingested before eruption of teeth. Reduction of caries continues at about 60% in persons drinking fluoridated water only as long as fluoride washes over teeth. One-half the population of the US does not have access to water with an optimal fluoride concentration of about 1 mg/L. Misinformation about fluoridation contributes to reluctance of communities to supplement the natural but inadequate fluoride of those water supplies. Fluoridation of water has no positive or negative effect on incidence or mortality rates due to cancer, heart disease, intracranial lesions, nephritis, cirrhosis, mongoloid births, or from all causes together. The collective decision to increase the natural fluoride content of water supplies is not an infringement of civil rights, nor does it establish a precedent in the binding sense of the law. Supplemental fluoride in water makes it available to all members of the community in a safe, practical, economical and reliable manner. Fluoridation saves money in dental costs and time lost from work. Fluoridation is an appropriate action of government in promoting the health and welfare of society.  Am J Clin Nutr 1985;41:129–138.

KEY WORDS  Fluoridation, nutrient, fluoride misinformation, caries reduction, stability of bone

Introduction

The wholesomeness of the community water supply is governed by law (1). Therefore, supplementation of the fluoride which occurs naturally in public water supplies is a political and potentially controversial public health policy (2, 3, 4, 5). Much of the debate centers around questions of safety and the appropriateness of using the public water supply to overcome any fluoride deficiency (2, 3, 6, 7).

Even though, as of 1977, approximately 35,000 papers had been published by scientists in a period of thirty years verifying the effectiveness and safety of water fluoridation (8, 9), questions are still being asked by those who oppose fluoridation and think that science has failed to provide answers (4, 5). It is essential that all evidence be presented to lay persons in a readily understandable form to allay fears based on misinformation (2, 7, 10).

Fluoride as a factor in food to promote reduction of carious teeth was known in 1892, when Sir Crichton-Browne advocated augmentation of what he called the “refined diet” of his era to re-incorporate the extracted fluoride (11). However, fluoride in water and not food was found to be a dental health factor by epidemiologists seeking the etiology of “brown stain” on otherwise healthy teeth (12, 13, 14, 15). The value judgment implicit

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in the language of this early epidemiological literature, although unsubstantiated by subsequent research (16, 17), may be the basis of much of the public confusion concerning the effects of fluoride in drinking water (2, 3).

The purpose of this paper is to provide some background information on fluoride; to clarify some of the misinformation about fluoridation by providing historical perspective on the determination of the health benefits of fluoride for teeth and bones, including some of the possible origins for current misinformation; to provide information on the physiological and therapeutic levels of effectiveness of fluoride; to discuss the safety of fluoride and fluoride supplementation of the community water supply as an acceptable, collective measure; and to indicate the high cost of misinformation in extra costs in health care which result from the low fluoride content of our water supplies.

**Occurrence and present status of fluoride**

Fluoride is present in soluble and variable amounts in all soils and therefore in all water. It is present in the plants and animals which humans eat for food (18). The fluoride concentrations in domestic United States water supplies vary from 0.1 to 10 mg/L (19–21). Sea water contains fluoride at 1.0 to 1.5 mg/L which results in a uniform concentration in seafood.

Like several trace elements, such as copper and magnesium, fluoride is classified by the National Academy of Sciences as an essential nutrient for body function in that no other element can replace it (22). Unlike other elements for which food is the major source, water is the most practical, consistent and effective source of fluoride as the washing over the teeth promotes partial and continued resistance to dental caries but only as long as the fluoridated water washed over the teeth (10, 13, 23–25). Fluoride imparts hardness to hydroxyapatite of bones which is retained by continued ingestion of fluoride (8, 25–27).

**Historical perspective**

The correlation between fluoride content of water and improved dental health was discovered accidentally by epidemiologists during the late 1800’s and early 1900’s in their search for the component(s) in the diet which caused brown staining of otherwise healthy teeth in people who lived in certain localities (15, 28–32). In 1929, water was identified as the source of the component (32). In 1931, in Churchill’s laboratory, the component was identified as fluoride (33).

During the 1930’s, chemical analyses to determine the fluoride levels were made of water in areas previously studied where brown staining of teeth occurred (12, 29, 30). Fluoride concentrations of 2 to 10 mg/L of water were found naturally in many plains, southwestern and southeastern states (29–31). No deleterious health effects were observed, other than cosmetic staining of tooth enamel when water was ingested before tooth formation, in a sample of approximately three million people living for a lifetime in those areas (15, 25, 30, 34, 35).

Dean (15, 29–32) and many others (12, 17) in carefully prepared and executed epidemiological investigations determined that when natural fluoride content of water was about 1 mg/L in a temperate climate, caries were reduced 50 to 60% when fluoride ingestion began before eruption of permanent molars. Cosmetic “white spots” on teeth associated with somewhat higher fluoride concentrations were not discernible (15, 28–30).

In the United States, beginning in the 1940’s, communities which had a water supply with fluoride content from 1.5 to 10 mg/L reduced the content to about 1.0 mg/L adjusted for seasonal temperature variation (36). Other communities which had a water supply with sub-optimal content of less than 1 mg/L voted to supplement the natural fluoride in the water (31, 36, 37). Fluoridation has been a public health issue since that time (7, 20, 25, 31).

Unfortunately, many of the early papers which were otherwise scientifically accurate discussed “fluorine” rather than the ionic component in water “fluoride” (12, 15, 17, 28–30) because fluorine, a gas, can be poisonous in small amounts, just as chlorine gas can be. Because fluoride compounds were then used in insect poisons, the specter of a poison was raised in some minds of the public (2–5, 38).

This specter was perhaps reinforced by the use in this early literature of such terms as...
“toxic,” “disease,” “endemic,” “low grade chronic fluoride poisoning,” “fluorosis,” and “mottling” when discussing cosmetic changes in children’s teeth as a result of ingesting 6 mg fluoride/L prior to tooth eruption, but not after (29). The investigations described in the paper just quoted are scientifically sound. The paper is cited only as being indicative of the value-judgmental terms used in early literature which are now being used by a misinformed segment of the public (2–5). These erroneous terms appeared in the literature for about forty years.

At other times, members of the medical profession have used facetious terms (in their opinion) which only confuse and alarm some of the public as exemplified in the title “Please Pass the Roach Poison” of an otherwise fine editorial which approved of the health effects of fluoridation of water (38).

“Mottling” of teeth is perhaps one of the most unfortunate terms and its use has caused much confusion because diagnosis was based on a presumed etiology of fluoride (28). Mottling, colored spots on teeth, is produced by factors other than fluoride and is actually reduced by ingestion of fluoridated water prior to tooth eruption (16, 17). Al-Alousi et al (16) clarified the term using a new classification approach based on the sound epidemiological principals that the recording of any condition once defined must be made on the basis of that definition and not on the basis of presumed etiology.

Recent papers by epidemiologists present the findings in positive terms which are easier for non-epidemiologists to understand and which are still scientifically correct (39, 40).

**Effectiveness of fluoride**

Fluoride ingested at optimal levels before eruption of permanent molars reduces caries an average of 50–60% (12, 13, 15, 19, 24, 31). Variables unrelated to fluoride intake, such as calcium and protein intake, cariogenic diet, and health care affect the incidence and severity of caries, thereby diminishing the precision with which protective effects of fluoridated water can be quantified (20, 23, 35, 41, 42).

Reduction of caries continues at 50 to 60% only if fluoride in water at approximately 1 mg/L washes over teeth for the lifetime of the teeth (19). If fluoride is withdrawn caries becomes more prevalent, although not to the extent which would have occurred had there been no exposure to fluoride in water prior to the eruption of the teeth (13, 19, 24, 43, 42). This is because fluoride is effective at two stages for formation and maintenance of healthy teeth and bones (41, 42, 44, 45). In the first stage of tooth development, systemic fluoride is incorporated into tooth structure prior to eruption and into bones at all stages of calcification (25, 31, 35, 42).

The second beneficial stage occurs after eruption of teeth and is related to the topical effect of fluoride in the drinking water washing over the teeth and becoming incorporated into crystal spaces (21, 42). Incorporation into bones and teeth continues until age fifty, at which time most spaces available to fluoride in the hydroxyapatite structure are filled (42). However, mineral repair processes continue to function and these require fluoride (46).

Additionally, in children, there is a reduced incidence of malocclusion, or improper meeting of the jaws and teeth because premature extraction of teeth is decreased by approximately 75% (23, 43). In adults, severe localized alveolar jawbone destruction leads to even greater loss of teeth than is caused by dental caries (25) and can be ameliorated by adequate fluoride in the water.

Among people living for a lifetime in areas where the fluoride content was 3.5 mg/L (8) or 8 to 10 mg/L women experienced reduced vertebral fractures and men reduced abdominal calcifications (26, 34, 35). The total ingestion could be from 5 to 16 mg daily. The possibility of reduced aortic calcification in men and the relationship between fluoride and magnesium in lessening calcification of soft tissues needs immediate study (8, 47).

**Therapeutic uses of fluoride**

The contribution of fluoride to increased hardness of bones led many investigators in the last fifteen years to administer fluoride at therapeutic levels to elderly patients with osteoporosis (18, 27, 48) and with otospongiotic syndrome (50, 49).

Treatment of some osteoporosis patients with 30 to 60 mg fluoride daily, adjusted to maintain a serum level between 5 and 10 µM, reduces the incidence of fractures, if
adequate calcium is administered and therapy is continued for at least three years (51). Bone strength may be increased with some loss of elasticity (51, 50). Increased plasma alkaline phosphatase levels are found suggesting that osteoblastic activity is stimulated with fluoride and calcium therapy (48, 52). Parathyroid hormone does not appear to be involved in the increased osteoblastic activity (52). Therapeutic levels of fluoride appear to reduce bone resorption, but may do so by affecting mineralization (49).

Lack of side effects at 30 to 60 mg of fluoride daily, or amelioration by adjustment of dosage or use of enteric coated capsules (48–50, 52–55) is noteworthy, in view of opposition to water fluoridation at 1 mg/L (4). Moreover, more than 4,000 patients with osteopontiots of the cochlear capsule have been administered moderate doses of fluoride, 22 to 36 or 60 mg daily, for up to 10 years, with general improvement of symptoms in about 80% of the cases and with few side effects (49, 50). More data are needed to determine the vertebral bone mass required to achieve optimal results and before general application of treatment to some osteoporosis patients is begun with therapeutic levels of fluoride (48, 51, 52).

Epidemiologic data suggest that much smaller intakes of fluoride than therapeutic levels at a younger age and over a longer period of time have beneficial effects, but do not entirely prevent the appearance of osteoporosis (8, 26). Bone resorption is apparently a process of aging which begins at about age forty and may be nearly irreversible (8). Identification of factors involved in prevention rather than treatment is needed (8, 21, 25, 26, 56).

Is fluoride then harmless?

Fluoride is like other nutrients and minerals; there is a toxic level (17, 57). Acute toxic doses of fluoride for humans are of the order of 2.5 to 5 g, if consumed at one time. This is from 42 to 84 mg/Kg for a 60 Kg adult, 5 and 10 g, respectively, as sodium fluoride (17). Effects of non-toxic doses have been described by two investigators who ingested approximately 114 mg fluoride at one time (250 mg NaF) for experimental purposes (17). Slight nausea and epigastric distress lasted about five hours in one case and 24 hours in the other; salivation was intense for about 30 minutes and ceased in an hour and a half; an intense itching sensation in the hands and feet lasted for about one week in one investigator. Assuming a body weight of 60 Kg the intake was approximately 1.9 mg F/Kg at one time. If water containing 8 mg F/L is ingested this represents about 0.27 mg/Kg for 2 L daily, as is done by some lifetime residents of some Texas cities (26, 34). At 1 mg F/L an adult (60 to 72 Kg) ingests about 0.028 to 0.033 mg/Kg from 2 L of water. For comparison, drinking one cup of tea represents an intake of 1 to 4 mg fluoride (20, 21, 31).

Margin of safety

Roe (57) discussed nutrient toxicity with excess intakes of iron and copper in terms which are applicable to fluoride:

"Dietary components which exert physiological functions and which therefore may be characterized as nutrients, can exert adverse effects when consumption exceeds the optimal level ... the actual occurrence and severity of toxic effects depends not only on the level of intake, but also on the ability of the body to eliminate the nutrient excess. ..."

In introducing these topics it is important to realize that many of the circumstances including mineral overload are rare, and great caution should be placed on any interpretation which suggests that because a particular mineral excess under specific condition be dangerous, therefore ingestion of such a mineral should be minimized. Such an inference may be considered as a reductio ad absurdum, but in this period of the fluoridation controversy and discussion of food additives it must be mentioned...

Symptoms of intoxication due to excessive mineral intake appear only to occur under peculiar circumstances. In general, large differences exist between the nutritional requirements for any given mineral and the toxic dose. Even if the dietary intake is high, absorption and retention are conditioned by physiological requirements." (57).

Lack of fluoride effect on disease and/or mortality rates

No effect of fluoride at 1 mg/L in drinking water has been shown to be positively or
negatively related to disease or death rates (3, 21, 39, 58). Numerous studies made in cities before and after initiation of supplemental fluoridation showed no changes in death rates from cancer, heart disease, intracranial lesions, nephritis, cirrhosis, or from all causes (3, 39, 58, 59). The good health and longevity of about seven million residents in the United States who lived for several generations where the natural fluoride concentration was 2 to 10 mg/L of drinking water attest to the lack of harm (26, 28–30, 32, 34, 35).

Although opponents of fluoridation have cited evidence in support of increased incidence of mongoloid births (Down Syndrome), cardiovascular disease and cancer after supplemental fluoridation of water supplies (4, 5), such studies have subsequently been shown to have omitted critical explanatory variables or to have failed to record all pertinent data (3, 39, 40, 58–62).

For example, in some cities with fluoridated water the population is older than in non-fluoridated cities (34, 35). Older persons die of cancer and heart disease more often than younger persons and the data must be corrected for age distribution (39, 58–62). Other corrections often omitted by those who oppose fluoridation are sex, race and socio-economic factors (4, 5).

No effect on mutagenesis

Fluoride has been shown to not have a mutagenic effect on chromosomes in either in vivo studies in cattle (63) or mice (64) or in vitro studies (63, 64). Published reports stating that fluoride is an antimutagen (65) have been corroborated by others who suggest a trivial reason for the antimutagenic effect, that fluoride prevented uptake of the mutagen (66).

Fluoride is not of the class of electrophilic compounds capable of interacting with deoxyribonucleic acid, nor is it likely that fluoride at tissue levels from the low quantities ingested would interfere with enzymic action during DNA replication (55).

Lack of allergic response

Fluoride has been purported to cause “allergic response” at 1 mg/L in water or when 1 mg fluoride is administered in tablet form (4, in 2, in 3). A review of the scientific literature fails to provide any scientific evidence for the allegation. On the contrary, studies with several thousands of children receiving sodium fluoride in tablet form for several years carry no report of allergenic response (67).

No allergic response to fluoride has ever been described among the world’s billions of consumers of the fluoride-rich beverage, tea which provides 1 to 4 mg fluoride per cup (31, 20, 21).

Several hundred patients with multiple myeloma were treated with 50 to 100 mg of fluoride daily, in divided doses, for up to 70 months (53, 54). Similar side effects occurred in control patients receiving placebos with the same frequency as patients receiving fluoride (53). Although the therapeutic effect on myeloma is still uncertain, the lack of excess side effects attributable to fluoride is important (53, 54).

Following such allegations as Waldbott’s (4) that urticaria is a “common manifestation of the disease,” the American Academy of Allergy evaluated the issue and concluded, unanimously: “There is no evidence of allergy or intolerance to fluorides as used in the fluoridation of community water supplies.” (3).

Kidney effects not found

Fluoride has been purported to cause kidney damage perhaps because of its excretion in a hydrated form as though it were water (68); and perhaps because of animal experiments which have used several hundred to thousand times human intakes (69). At these high levels, if the animals survived, there was some tubular degeneration (69).

Experiments on non-humans at such excessive levels are irrelevant to a determination of metabolic effects of fluoride at the low levels ingested in fluoridated water by humans (55). However, these experiments have been used to substantiate claims of “fluoride toxicity” as pertinent to water supply levels (4, 69).

One carefully controlled study using the most sophisticated methods available of early fluoride supplementation of domestic water supplies, determined that the differences between the two groups of twelve year old boys from a community where the water was essentially fluoride-free and one in which the
water supply had been fluoridated for eight years tended to favor the children who had been living with fluoridated water as being in the healthier range (37).

Again, unfortunately, the abstract for this article contains the sentence which has been quoted directly by opponents of fluoridation, "The Newburgh (fluoridated water) boys did not differ significantly from the Kingston (non-fluoridated water) boys in incidence of abnormal findings" (69). The implication that the Newburgh boys were "abnormal" but not statistically significantly so is of course erroneous, as reading the complete article makes clear.

Studies of aluminum workers over 15 years have not shown evidence of kidney damage where fluoride intake occurs by inhalation and with post-working shift urinary fluoride of less than 7 mg/L (70-72). No kidney changes were found in life-time residents where water contained fluoride at 8 mg/L (25, 34, 35, 55) or in osteoporotic patients treated with 20 to 50 mg fluoride per day (26, 35, 54).

In hemodialysis, the fluoride concentration as well as other minerals in the dialysis solution, should be controlled (20). A kidney abnormality sufficient to impair normal fluoride excretion would probably prove fatal prior to development of high fluoride levels, since toxic body metabolites could not be satisfactorily excreted (20, 32).

Lack of parathyroid effect

Because fluoride is deposited in hydroxyapatite of bones as well as teeth, it has been suggested as having a deleterious effect on bone by enhancing the process of bone resorption (in 4). The mechanism would presumably be by stimulation of parathyroid secretion. Parathyroid hormone exerts a direct effect on bone resorption by increasing osteolysis around large osteocytes and by stimulating the development of osteoclasts from cellular precursors (73).

In fact, administration of excessive amounts of parathyroid hormone to marmosets which had been given water containing either 50 mg/L or no fluoride, indicated a protective action of fluoride in preventing resorption of alveolar bone (73). Therapeutic levels of fluoride do not increase parathyroid levels in humans with osteoporosis (52).

Roholm (74) did not find bone resorption in individuals who may have inhaled 20 to 80 mg fluoride daily for 10 to 20 years.

Several reports have indicated that fewer fractures in older residents of North Dakota and Texas, consuming 4 to 8 mg F/L in a life-time residency, may be attributable to a protective action on bone resorption by the fluoride although the concentration of parathyroid hormone was not determined (8, 26).

Metabolic experiment: one example

Recent studies of a metabolic nature suggest that fluoride at physiological levels activated the adenylate cyclase system which is a mediator of hormone effects (75). Continued research is needed to examine the relationship between fluoride, magnesium and calcium in possible reduction of soft tissue calcification (8, 26, 47).

Clearly we are learning more about fluoride metabolism, rather than trying to ascribe a cause and effect role for fluoride. Much more investigation of a metabolic type needs to be done to determine how best to have this element contribute to our well being.

Chronic effects of fluoride

Interpretations of chronic effects of fluoride by detractors also depends on citing statements and work out of context (4, 5). Chronic effects of mild osteosclerosis (abnormal hardening of bones) may result from 20 to 80 mg fluoride if ingested daily for 10 to 20 years (31, 74). A report by Roholm (31, 74) about individuals who worked in a cryolite (sodium aluminum fluoride) plant is often cited as evidence that fluoride causes "Toxic reactions in bone and soft tissue. . . . Resulting in bone destruction and calcification of ligaments" (in 4).

Roholm reported a study of 68 cryolite workers, of whom 50 had slight or moderate sclerosis; seven others who had advanced skeletal changes also had some calcification of ligaments and tendinous insertions (31, 74). Minor gastro-intestinal and joint symptoms were frequent in otherwise healthy individuals. Except for restricted mobility of the spine of the most severely affected workers, the physical examination and tests of blood and urine were "not remarkable" suggesting that no kidney damage occurred. Roholm reported "All signs of bone destruc-
tion are absent from the picture" (56) suggesting the lack of parathyroid effect on resorption.

The unusual changes described in the Roholm report have typified the "effects of fluoride exposure" used by detractors (4). These findings, taken out of context, and their erroneous interpretation by others (4, 5) represent a bias in the assessment of the effects of physiological fluorides similar to the early bias in the "discovery" that fluoride causes "mottling" of teeth. This bias has pervaded the evaluation of data concerning domestic water supplies containing trace amounts of natural or added fluoride (2, 3).

Total fluoride intake and margin of safety

Concern has been expressed about the total fluoride content of diet, water and air intake reaching levels which might be deleterious if water is fluoridated at approximately 1 mg/L (4). Daily ingestion of fluoride in food and water accounts for substantially all the fluoride intake, from 0.2 to 0.6 mg from food unless unusual amounts of seafood or beverage tea are consumed, and from 1 to 2 mg from water (10, 20, 76). Urban air usually contains less than 1.0 μg/m³ (76). An adult breathing 20 m³ in 24 hours could inhale 0.02 mg fluoride, an insignificant amount.

Some industrial processes can release fluorides into the air in the plant and downwind of the industry. The National Institutes of Occupational Safety and Health (NIOSH) 1975 Criteria and the Occupational Safety and Health Administration (OSHA) standards of 2.5 mg/m³ for "inorganic fluorides" and "HF" allows a safety factor for fluoride (76). A maximum exposure at this level would be equivalent to drinking water containing 8 mg F/L for a lifetime; a level which does not cause development of osteosclerosis after 10 to 43 years occupation exposure (26, 34, 71, 72, 76).

Humans living for 15 years in areas downwind from industrial plants have not shown bone changes and only slightly increased fluoride excretion (14, 70). Food preparation processes for humans remove surface dust from local vegetation, thereby not contributing to increased intake by ingestion (77).

The margin of safety for fluoride ingestion appears to be about 100 to 1 between the dosage effective in reversing osteoporotic lesions in the elderly and a toxic level for adults who are not forming teeth. This level of safety is about the same as for aspirin in relieving a headache (9, 50).

Is the decision to fluoridate community water supplies a collective measure which can be tolerated by the population?

Fluoridation of the drinking water has been perceived by some as a "medication" rather than supplementation of a natural component (78). Opponents of fluoridation argue that supplemental increases to optimal levels constitutes an infringement of civil rights and sets a precedent for subsequent addition of harmful components to water (78). Fluoride does not cure any disease. Fluoride is not a medicine. It is a nutrient which enhances the stability of teeth and bones and is a partial preventative of caries and hardens bones (41, 42, 44).

That fluoridation sets a dangerous precedent was refuted by the Honorable Malcolm Peter Crisp, a Justice of the Supreme Court of Tasmania (6): "I suggest that it is a confusion of thought to allow values to be determined by secondary characteristics. The question is: what is benefit and what is detriment? If it be beneficial, then to reject it because it might constitute a 'precedent' is the argument of timidity. . . . In the sense of providing a reference point in future discussion, fluoridation would constitute a precedent. In no way could it be said to be a precedent in the binding sense (it is a matter of decision of elected representatives which cannot bind future elected officials) in which the term is used in the law."

The question of how far the rights of individuals in a given society should be curtailed in the public interest is one which constantly recurs in the political sphere (2, 7). An individual's right to live life as she or he pleases in our society supposes a balance, consideration of the risk and benefit to others, and of safety and effectiveness. Government acts in a myriad of ways to protect the rights and welfare of the general populace and fluoridation of water is an economical and sound contribution to a healthy society as a whole.

Cost of lack of water fluoridation

Since adjustment of fluoride content of water supplies, either up or down, began in
the United States in the 1940's, approximately 50% of the residents, served by 13% of the water districts, have voted to have access to community water with approximately 1 mg fluoride/L (36, 79). Of this 50%, approximately 10% have access to supplies with natural fluoride content between 1 and 4 mg/L. This leaves approximately 110,000,000 people with a fluoride deficiency in the water supply. These residents are in 87% of the water districts which do not supplement the natural fluoride content of water (79). If each of these 110,000,000 residents had two untreated carious teeth, a lower limit, one of which could have been prevented by a modest supply of fluoride, the cost of non-fluoridation may be estimated at $3 billion for fillings alone (see 23). In 1968, Hegsted reported an estimated one billion untreated carious teeth in the United States making the cost of deficiency of fluoride even higher (8, 23).

Costs of non-fluoridation were estimated at $8 billion in 1978, in time lost from work, not including fillings of teeth (2). Alternatives to water fluoridation are available but are more expensive than water fluoridation and long-term compliance is seldom attained (67).

Scientific data is available to be given to the lay public in terms which can be understood, but there is still reluctance on the part of the health professional to become involved in the political process (2, 7).

Recent recommendations for Dietary Goals for England included optimal use of fluoride in drinking water and prevention of pickets and osteoporosis (17). In the United States the National Research Council of the National Academy of Sciences recommends fluoridation of public water supplies to about 1 mg/L for partial prevention of dental caries (22).

The Report of the Director-General, WHO, to the 28th World Health Assembly in 1975, states that “fluoridation of communal water supplies should be the cornerstone of any national program of dental caries prevention” (56). A further recommendation was that studies be made of increased fluoride intake after permanent tooth eruption as a means of improving the quality of the skeleton (56).

It may well be that the advantages which accrue to older people consuming appropriate quantities of fluoride during their early bone and teeth formation periods, may have as much significance as does the prevention of dental caries in children (8, 25, 80).

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