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"Fluoridation of public water supplies is a safe, economical, and effective measure to prevent dental caries."

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Fluoridation of Public Water Supplies

Policy Statement

Fluoridation of public water supplies is a safe, economical, and effective measure to prevent dental caries. Family physicians should know the fluoride content of local drinking water supplies, educate patients to prevent excessive fluoride intake, and be knowledgeable about the health risks and benefits associated with fluoride. Dietary fluoride supplements should be considered for children from ages 6 months through 16 years when drinking water levels are suboptimal.

Introduction

Since the addition of fluoride to public water supplies was initiated in 1945, exposure to fluoridation continues as a persistent public health issue. It is estimated that 62% of the United States population in 1989 resided in areas served by fluoridated drinking water supplies.[1] Fluoride is a ubiquitous element found at varying levels in all diets. In addition to fluoridated water, other sources of fluoride include foods and beverages produced in areas with fluoridated water, dentifrices, fluoride-containing mouth rinses, dental treatment products, and dietary supplements. Efforts to quantify fluoride intake have proven difficult due to variable fluoride content within products as well as variation in amounts consumed.[2]

Observational studies by Dean and colleagues during the 1930s identified reductions in dental caries at a naturally occurring fluoride concentration of 1 mg per liter.[3,4] This level of fluoride resulted in decreased caries prevalence without objectionable levels of dental fluorosis, prompting the adoption of this concentration as an optimal level. In 1993, the National Research Council [5] concluded that there was not sufficient evidence to support changing the upper limit of 1.2 parts per million (ppm) of fluoride in drinking water. More recently, the U.S. Public Health Service reviewed this drinking water standard and reaffirmed optimal levels of 0.7 to 1.2 ppm fluoride (dependent on annual average of maximum daily air temperatures) to yield an average of 1 mg per day of consumed fluoride.[6] Where the fluoride content of drinking water is naturally increased, the Environmental Protection Agency recommends reductions to a level of 2.0 ppm. Water sources with fluoride levels of 0.0 to 0.3 ppm are considered to be non-fluoridated.

The Healthy People 2000 document [1] contains reference to the issue of fluoride as it relates to health of the American public. Specific objectives relevant to fluoridation include:

- objective 13.9: Increase to at least 75 percent the proportion of people served by community water systems providing optimal levels of fluoride. (baseline: 62 percent in 1989)
- objective 13.10: Increase use of professionally or self-administered topical or systemic (dietary) fluorides to at least 85 percent of people not receiving optimally fluoridated public water. (baseline: 50 percent in 1989)

The reported benefits and risks associated with exposure to fluoride are highlighted in the following sections.

Benefits

Dental Health

Numerous reports documenting that exposure to fluoridated water supplies during adolescence results in reduced dental caries prevalence have appeared in a variety of sources. [7] These studies, comparing fluoridated and non-fluoridated communities, have reported decreases in the overall prevalence of dental caries and for summary scores of dental decay identified as the "DMF" for permanent teeth and the "df" for primary teeth. These summary scores represent the cumulative caries experience based on the number of decay (D or d), missing (M) or filled (F or f) tooth surfaces. Additional studies have documented increased caries prevalence following withdrawal of fluoride supplementation of drinking water.[8,9]

Comparable decreases in caries prevalence have also been observed in communities in non-fluoridated areas. Suggested reasons for this include greater use of fluoride-containing dental care products, reductions in the consumption of refined sugar, better access to and utilization of dental health services, improvements in oral hygiene and increased awareness of dental health.[10,11,12]

While the majority of published studies have examined dental health among adolescents, dental decay is also common during the later years of life in the form of root surface caries. Fewer carious lesions have been identified among older persons residing in communities with optimal fluoride levels. [13,14]

Several factors may be operative in observed temporal declines in caries prevalence including improved access to dental care, enhanced knowledge of dental hygiene, expanded use of fluoride-containing dental care products and

increased exposures to fluoride through foods and beverages. Overall, the preponderance of evidence indicates that fluoride is beneficial to dental health.

The action of fluoride on teeth involves both topical and systemic mechanisms. Fluoride acts to stabilize the hydroxyapatite matrix on internal and external tooth surfaces.[15,16] Topical application of fluoride has been shown to decrease levels of dental plaque bacteria.[17] Systemic fluoride is provided by fluoridated public water supplies, dietary supplements, foods, and beverages. Sources of topical fluorides include fluoride-containing dentifrices, mouth rinses, and gels.

Dental caries is a health problem which impacts on the medical, functional, nutritional and psychological status of patients in all age groups. The prevalence of dental caries is 42% at five years of age, increasing to more than 84% by age 17.[18,19,20,21] The Health Care Financing Administration estimates that 5% of the total health care expenditures (or $34 billion dollars) is spent on dental services of which 13.2% (or $4.5 billion) is used for amalgam restoration.[20]

Other Potential Benefits

While fluoride is known to stimulate osteoblastic activity this newly formed bone is histologically abnormal. No consensus exists with respect to the duration or dose of fluoride as a possible therapy for osteoporosis. [22]

Risks

Acute Toxicity

Acute toxic effects from fluoride occur at doses of 1-5 mg/kg. Symptoms of toxicity include nausea, vomiting, diarrhea, sialorrhea and abdominal pain, often accompanied by seizures, cardiac arrhythmias, and coma.[23,24,25]

Fluorosis

Chronic exposures to fluoride may result in dental fluorosis or skeletal fluorosis. Dental fluorosis, which is variable in clinical presentation, occurs from exposure to increased levels of fluoride during tooth formation. While various presentations of dental fluorosis are seen throughout the United States, it is generally considered more of a cosmetic problem since it rarely compromises dental or oral function. The prevalence of fluorosis is dependent on the criteria used to define the problem.

While excessive chronic fluoride exposure may result in skeletal fluorosis, this manifestation is extremely rare with only a handful of cases reported during the past 30 years. A study of persons exposed to drinking water sources with >4 mg/liter (e.g., >4 ppm) of fluoride showed no evidence of radiographic change.[26]

Cancer

Interest in the potential carcinogenicity of fluoride resurfaced when a National Toxicology Program study of rodents with life-long fluoride exposures reported an increased incidence of osteosarcomas among male rats ingesting a high fluoride diet.[27] However, this same study failed to demonstrate differences in cancer occurrence among female rats or among male or female mice. This report prompted an examination of incidence rates for osteosarcomas, and all bone cancers combined, in fluoridated and non-fluoridated communities, which revealed no significant differences.[28] In addition, total lifetime fluoride exposure was not found to be associated with risk of developing osteosarcoma.[29]

Previous reports which compared cancer mortality [30,31,32,33,34,35) in fluoridated and non-fluoridated areas revealed no association with fluoride levels in drinking water. Similarly, studies of cancer incidence in fluoridated and non-fluoridated communities identified no significant differences.[30,36] An additional study of persons occupationally exposed to fluoride reported elevated incidence for cancers of the respiratory tract,[37] most likely resultant from smoking habits rather than fluoride exposure.

Bone Fractures

Studies of hip fracture rates and fluoridated drinking water supplies have yielded no consistent results.[38,39,40,41] Further studies are needed to resolve these inconsistencies.

Other Potential Risks

Knowledge regarding the reproductive and genotoxic effects of fluoride is limited. Available evidence does not support an association between fluoridated drinking water supplies and congenital malformations. Data on the genotoxic effects of fluoride in human populations are unavailable.

Further information on the reported risks and benefits of fluoride exposure is available in primary sources as well as comprehensive review papers on this topic. [42,43]

Dietary Supplementation

A comprehensive history-taking is essential before fluoride is prescribed as a dietary supplement. The history should include a review of previous residences and fluoride status of drinking water supplies, travel history, sources of drinking water, method of infant feeding, the use of dietary supplements containing fluoride, and the use of fluoride containing products for dental care. Physicians should also be alert to possible sources of regional environmental

fluoride contamination (e.g., industrial emissions). Taken together, this information is utilized to determine an estimate of the current fluoride intake of an individual, recognizing inherent limitations in knowing the precise fluoride content of processed foods and beverages. This provides the basis on which a health professional can prevent unnecessary and inappropriate fluoride intake. Local public health officials are able to provide information on the fluoride content of water that is supplied from public sources. Where drinking water is obtained from underground sources and private wells, chemical analysis is needed to determine the fluoride content.

The American Academy of Pediatrics (AAP) has issued a schedule for fluoride supplementation [44] (see Table 1). These recommendations take account of the levels of fluoride contained in the primary drinking water supply as well as the age of the pediatric patient. Changes in the current AAP schedule include the elimination of fluoride supplementation during the first six months, decreased doses of supplemental fluoride from age six months to six years, and decreasing the level at which no supplementation is needed from 0.7 ppm to 0.6 ppm. Dietary supplementation among children in fluoride-deficient communities is also supported by the U.S. Preventive Services Task Force.[45]

The magnitude of scale which exists between typical exposures and exposures likely to result in untoward health effects refers to the term "margin of safety." It is important to recognize that a relatively narrow margin of safety may exist for development of dental fluorosis among children consuming fluoridated drinking water or consuming fluoride supplements. Patients should be cautioned about the toxicity of fluoride when it is prescribed in tablet or liquid form. Parents should monitor their children's use of dentifrices and other dental products that may represent sources of excessive fluoride ingestion. Physicians should be aware of the fluoride levels in water supplies, as well as possible sources of regional environmental fluoride contamination, so as to appropriately prescribe supplements.

To minimize the risk of systemic ingestion of topical fluoride agents children should be supervised when using products containing fluoride. Toothpaste contains fluoride at a level of 1 mg /gram, thus unsupervised children can ingest excessive fluoride. For example, a two-year old, brushing his/her teeth twice a day, could ingest as much as 0.5 mg a day.

Dental caries represents a health problem which impacts on the medical, functional, nutritional, and psychological status of patients. Fluoridation of public water supplies is a safe, economical, and effective measure to prevent dental caries. When drinking water levels of fluoride are suboptimal, dietary supplementation should be considered. (1996) (2002) (2008)

Table 1. Schedule for Fluoride Supplementation

Fluoride content of drinking water (in parts per million [ppm])

CHILD'S AGE	<0.3 PPM	0.3-0.6 PPM	>0.6 PPM
birth to six months	0 mg	0 mg	0 mg
six months - 3 years	0.25 mg	0 mg	0 mg
3 - 6 years	0.50 mg	0.25 mg	0 mg
6 - 16 years	1.00 mg	0.50 mg	0 mg

Source: American Academy of Pediatrics, Committee on Nutrition. Fluoride supplementation for children: interim policy recommendations. Pediatrics 1995; 95: 777.[44]

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