

Fluoride

Function

Most fluoride in the body is found in bones and teeth, due to its high affinity for calcium. Ingestion of and topical treatment with fluoride is effective in inhibiting or even reversing dental caries. Fluoride deposition into the dental enamel in the form of acid-resistant fluoroapatite crystals, especially during preeruptive tooth development, is a critical factor in reducing the incidence of dental caries. Because it can stimulate growth of new bone, fluoride has been used experimentally to treat osteoporosis (Food and Nutrition Board 1997). Despite these well-documented beneficial effects, there is no scientific agreement that fluoride should be considered an essential element—in other words necessary for the life of the individual and continuation of the species.

Safety Evidence

Fluoride toxicity is well known and has been extensively reviewed (Public Health Service 1991; Food and Nutrition Board 1997; IRIS 2003). The critical adverse effects (i.e., those significant adverse consequences that occur at the lowest intakes) are dental fluorosis in children and skeletal fluorosis in adults. Excessive intake in children before the permanent teeth are fully formed can result in dental fluorosis that manifests itself mainly as mottled brown discoloration and some increase in fragility. Dental fluorosis has been studied in relation to both municipal drinking water fluoridation (for the anticariogenic effect) and naturally occurring high-fluoride water supplies. The maximum fluoride intakes by children that will safely avoid dental fluorosis depend on age and body size.

Excessive intake of fluoride by adults results in skeletal fluorosis, which carries an increased risk of bone fracture. The FNB, however, may have somewhat underestimated the potential for fluoride to increase bone fracture risk. Some epidemiological data suggest that an increased rate of bone fracture is associated with drinking water containing high fluoride concentrations (4 mg per L) and low calcium concentrations (15 mg per L) (Public Health Service 1991).

The epidemiological data do not present any clear pattern of association of fluoride intake with cancer risk (Public Health Service 1991). Animal studies are almost all negative for carcinogenicity of fluoride compounds found in water and food. The sole exception is the finding of “equivocal evidence” of the carcinogenicity of sodium fluoride in the male Fisher 344/N rat. With the large number of studies performed, a single study that suggests possible significant effects is not surprising. No other data suggest an increased cancer risk related to fluoride consumption.

Published Official Reviews of Fluoride Safety

The FNB UL for adults, representing the level at which skeletal fluorosis may be avoided, is 10 mg per day, based on an adult NOAEL of 10 mg and a UF of 1.0 (Food and Nutrition Board 1997). Such a UL was justified by the lack of change in skeletal density found at higher intakes.

For younger age groups with incomplete dental enamel development and maturation, FNB selected dental fluorosis as the critical endpoint. On the basis of dose-response relationship data that indicated lower NOAEL and LOAEL values for these younger age groups, FNB identified correspondingly lower UL values (0.7 mg per day for infants zero to six months; 0.9 mg for seven to twelve months; 1.5 mg for one to three years; and 2.2 mg for four to eight years) (Food and Nutrition Board 1997).

The UK EVM considered fluoride for evaluation but declined to review it or offer an opinion because “it is inappropriate to comment on fluoride with regard to food fortification since this [the fluoridation of drinking water] is carried out as a public health measure” (Expert Group on Vitamins and Minerals 2003).

CRN UL for Fluoride for Adults

High intakes of fluoride can have adverse effects on the kidneys and the immune, gastrointestinal, genitourinary and respiratory systems. All of these effects occur at intakes higher than those that may cause skeletal fluorosis and possibly increase bone fracture risk. Thus, none can be considered the critical effect for identifying a UL. Instead, CRN, in agreement with FNB, identifies skeletal fluorosis as the critical effect in the evaluation of fluoride safety for adults.

The data associated with a daily intake of 1.5 L of fluoridated drinking water suggest that an increased risk of fracture related to skeletal fluorosis might occur with intakes of 6 mg of fluoride or more per day from this source. Thus, if the fluoride intake from foods and nonfluoridated water is approximately 1 mg per day, and the intake from fluoridated toothpaste is approximately 1 mg per day, the addition of these quantities to the 6 mg per day for high-fluoride water suggests that a total intake of 8 mg per day increases the risk of bone fracture in persons whose drinking water has low calcium concentrations. The adult LOAEL, then, is 8 mg per day. This contrasts with FNB’s adult NOAEL of 10 mg per day. A UF of 1.3 is adequate for application to such a conservative LOAEL, particularly given NAS’s selection of a UF of 1.0 for a NOAEL of 10 mg (producing a calculated UL of 10 mg). Therefore, CRN’s calculated UL is 6 mg. CRN does not identify a ULS for adult fluoride supplementation.

From: **Vitamin and Mineral Safety 2nd** Edition ~ by John N. Hathcock, Ph.D.
Council for Responsible Nutrition (CRN) All rights reserved. Republication or redistribution of
content is expressly prohibited without prior written consent of CRN.

Comparison of Safety Values for Fluoride

CRN UL (not a ULS)	6 mg
US FNB UL	10 mg
EC SCF UL	Not reviewed (as of May 2004)
EC supplement maximum	Not established (as of May 2004)
UK EVM SUL	Not to be reviewed

References

Expert Group on Vitamins and Minerals. Safe upper levels for vitamins and minerals, Food Standards Agency, United Kingdom, 2003.

Food and Nutrition Board. Dietary reference intakes for calcium, phosphorus, magnesium, vitamin D, and fluoride. Washington, DC: National Academy Press, 1997.

IRIS. Integrated risk information system database IRIS-NCAR (non-carcinogenic). U.S. Environmental Protection Agency. [In process] Available through TOXLINE, 2003.

Public Health Service, Ad Hoc Subcommittee on Fluoride. Review of fluoride benefits and risks. Bethesda: Department of Health and Human Services, 1991.