FLUORIDES, HYDROGEN FLUORIDE, AND FLUORINE

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POPULATIONS THAT ARE UNUSUALLY SUSCEPTIBLE

Existing data indicate that subsets of the population may be unusually susceptible to the toxic effects of fluoride and its compounds. These populations include the elderly, people with deficiencies of calcium, magnesium, and/or vitamin C, and people with cardiovascular and kidney problems.

Because fluoride is excreted through the kidney, people with renal insufficiency would have impaired renal clearance of fluoride (Juncos and Donadio 1972). Fluoride retention on a low-protein, low-calcium, and low-phosphorus diet was 65% in patients with chronic renal failure, compared with 20% in normal subjects (Spencer et al. 1980a). Serum creatinine levels were weakly correlated (r=0.35-0.59) with serum fluoride levels (Hanhijarvi 1982). People on kidney dialysis are particularly susceptible to the use of fluoridated water in the dialysis machine (Anderson et al. 1980). This is due to the decreased fluoride clearance combined with the intravenous exposure to large amounts of fluoride during dialysis. Impaired renal clearance of fluoride has also been found in people with diabetes mellitus and cardiac insufficiency (Hanhijarvi 1974). People over the age of 50 often have decreased renal fluoride clearance (Hanhijarvi 1974). This may be because of the decreased rate of accumulation of fluoride in bones or decreased renal function. This decreased clearance of fluoride may indicate that elderly people are more susceptible to fluoride toxicity.

Poor nutrition increases the incidence and severity of dental fluorosis (Murray and Wilson 1948; Pandit et al. 1940) and skeletal fluorosis (Pandit et al. 1940). Comparison of dietary adequacy, water fluoride levels, and the incidence of skeletal fluorosis in several villages in India suggested that vitamin C deficiency played a major role in the disease (Pandit et al. 1940). Calcium intake met minimum standards, although the source was grains and vegetables, rather than milk, and bioavailability was not determined. Because of the role of calcium in bone formation, calcium deficiency would be expected to increase susceptibility to effects of fluoride. No studies in humans supporting this hypothesis were located. Calcium deficiency was found to increase bone fluoride levels in a two-week study in rats (Guggenheim et al. 1976) but not in a 10-day study in monkeys (Reddy and Srikantia 1971). Guinea pigs administered fluoride and low-protein diet had larger increases in bone fluoride than those given fluoride and a control diet (Parker et al. 1979). Bone changes in monkeys following fluoride treatment appear to be more marked if the diet is deficient in protein or vitamin C, but the conclusions are not definitive because of incomplete controls and small sample size (Reddy and Srikantia 1971). Inadequate dietary levels of magnesium may affect the toxic effects of fluoride. Fluoride administered to magnesium-deficient dogs prevented soft-tissue calcification, but not muscle weakness and convulsions (Chiemchaisri and Philips 1963). In rats, fluoride aggravated the hypomagnesemia condition, which produced convulsive seizures. The symptoms of magnesium deficiency are similar to those produced by fluoride toxicity. This may be because of a fluoride-induced increase in the uptake of magnesium from plasma into bone.

Some people with cardiovascular problems may be at increased risk of fluoride toxicity. Fluoride inhibits glycolysis by inhibiting enolase (Guminska and Sterkowicz 1975; Peters et al, 1964). It also inhibits energy metabolism through the tricarboxylic acid cycle by blocking the entry of pyruvate and fatty acids and by inhibiting succinic dehydrogenase (Slater and BoMer 1952).

There is evidence that daily doses of 34 mg fluoride (0. 48 mg/kg/day) increases the risk of nonvertebral fractures in women with postmenopausal osteoporosis (Riggs et al. 1990). Postmenopausal women (Danielson et al. 1992; Sowers et al. 1991) and elderly men (Danielson et al. 1992) in fluoridated communities may also be at increased risk of fractures.