

THE DARK SIDE OF FLUORIDE

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ABSTRACT: Although the topical use of fluoride, including the use of silver diamine fluoride, is beneficial in altering the mineralization-demineralization balance in the dental enamel and arresting dental caries, the use of fluoride has a dark side, particularly when it is taken systemically to prevent dental caries as in water fluoridation when the fluoride level in the drinking water is adjusted to a level of about 0.7 mg/L. The dark side of fluoride is that fluoride can produce neurotoxicity in the developing brain at levels below those used in water fluoridation. Using the data from high quality studies, in which the maternal urine levels during pregnancy and the IQ of the children have been studied on an individual basis, it has been found that the safe exposure level to fluoride in pregnancy for the prevention of developmental neurotoxicity is considered to be one that results in a maternal urinary fluoride level of less than approximately 0.2 mg/L, which corresponds to a drinking water fluoride level of less than 0.4 mg/L.

Keywords: Dark side of fluoride; Fluoride-induced neurotoxicity.

Although the topical use of fluoride, including the use of silver diamine fluoride, is beneficial in altering the mineralization-demineralization balance in the dental enamel and arresting dental caries, the use of fluoride has a dark side, particularly when it is taken systemically to prevent dental caries as in water fluoridation when the fluoride level in the drinking water is adjusted to a level of about 0.7 mg/L.^{1,2} The dark side of fluoride is that fluoride can produce neurotoxicity in the developing brain at levels below those used in water fluoridation. Using the data from high quality studies, in which the maternal urine levels during pregnancy and the IQ of the children have been studied on an individual basis, it has been found that the safe exposure level to fluoride in pregnancy for the prevention of developmental neurotoxicity is considered to be one that results in a maternal urinary fluoride level less than approximately 0.2 mg/L, which corresponds to a drinking water fluoride level of less than 0.4 mg/L.³⁻⁵

The reduction of IQ with exposure at an early age to fluoride is considered to be an example of a human fluoride-induced developmental disorder (FIDD) resulting from disturbed thyroid hormone metabolism and sonic hedgehog signalling.⁶⁻⁷ Fluoride-induced developmental disorders may affect both hard and soft tissues with short stature, bone deformities, cognitive impairment, delayed dental eruption, and dental fluorosis.^{6,8,9} FIDDs involve an impairment of development at a critical time period and treatment at a later time is not able to fully remedy the deficits. Prevention of FIDDs is preferable as effective cures are not available. Developmental neurotoxicity may start with exposure of the foetus to fluoride during pregnancy and FIDDs can be prevented if fluoride exposure during pregnancy can be kept at a safe level.^{4,5,10} Some groups are at greater risk of FIDDs because of the presence of decreased thyroid function, particularly with an inadequate dietary iodine intake, or particular

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genotypes. Carton has noted that individuals with decreased thyroid function could be adversely affected with a daily fluoride dose of 0.7 mg/day, for a standard 70 kg person, and that since this is less than the amount already in the diet the maximum contaminant level goal (MCLG) for fluoride in drinking water should be zero.¹¹

Dental, skeletal, and non-skeletal fluorosis can be prevented by avoiding the excessive ingestion of fluoride, starting during the pregnancy. As noted, currently, the safe exposure level to fluoride in pregnancy for the prevention of developmental neurotoxicity is considered to be one that results in a maternal urinary fluoride level less than approximately 0.2 mg/L which corresponds to a drinking water fluoride level of less than 0.4 mg/L.³⁻⁵ In addition to using safe drinking water, other sources of fluoride should avoided such fluoride-rich foods, other dietary sources of fluoride, and other environmental sources of fluoride.¹⁰ Prevention will also be assisted by having an adequate dietary intake of vitamins, antioxidants, and selenium, e.g., vitamin C, vitamin E, and other antioxidants, from fruits and vegetables, which are seen to be able to protect against fluorosis.^{10,12} Selenium can improve mitochondrial membrane stability and protect against fluoride-induced toxicity in skeletal muscles although, at higher levels, selenium is synergistic with fluoride and arsenic in causing toxicity.¹⁰

CONCLUSIONS

Thus, the dark side of fluoride is that it is toxic to the developing brain during pregnancy and early childhood and the levels of fluoride used in water fluoridation of approximately 0.7 mg/L are unsafe. The safe level of fluoride in drinking water to prevent fluoride-induced neurotoxicity is less than 0.4 mg/L. There may be a place for the use of topical fluoride, including silver diamine fluoride, to prevent and arrest dental caries but the use of community water fluoridation for the prevention of dental caries can no longer be considered to be safe.

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