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Low Prenatal Exposures to Fluoride: Are There Neurotoxic Risks for Children?

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As a trace element, fluoride can help ward off dental cavities. Exceptionally high pre- and postnatal exposures, as seen in populations whose drinking water supplies are contaminated by natural fluoride sources, have been implicated in a number of adverse health effects.[1–4] However, less is known about fluoride's neurotoxic risks at lower levels of exposure. A new study in *Environmental Health Perspectives* examines risks of exposure to prenatal fluoride at concentrations typical of the general population.[5]

In many countries, small amounts of fluoride are added to drinking water, salt, or milk to reduce the incidence of tooth decay.[6–8] The U.S. Public Health Service recommends an optimal level of 0.7 mg/L fluoride in drinking water for caries prevention.[2] Fluoride can also occur naturally in water, with concentrations exceeding 4.0 mg/L in some areas of the United States[1]; this is the maximum contaminant level for fluoride set by the U.S. Environmental Protection Agency.[6]

There is some debate regarding whether fluoridation is still needed for drinking water. Fluoridation of public water supplies was started in 1945 in the United States as a preventive measure to reduce the incidence of tooth decay.[9] Most of the evidence for the benefits of fluoridation was collected prior to 1975, before widespread use of fluoride toothpastes and dental treatments[1,9] and before modern assessments of dietary sources of fluoride.[1,10] However, for people who do not have access to proper dental care, cutting off water fluoridation could cause them to get too little fluoride.

With high exposure—typically exceeding the maximum contaminant level—fluoride can accumulate in teeth and bones, causing tooth discoloration and weakness as well as bone pain and increased fracture risk.[1] An additional concern is potential neurotoxicity, particularly during fetal development and early childhood.[1,4,11] In a 2012 review of studies conducted in China and Iran,[3] children living in regions with very high levels of naturally occurring fluoride in drinking water had lower scores on intelligence tests than children living in regions with low water levels of fluoride.

Philippe Grandjean, a professor of environmental health at the Harvard T.H. Chan School of Public Health who coauthored the 2012 review, notes that the advantage of the studies in China is that they were primarily conducted in rural areas where families remained in the same place for an extended time. Therefore, when a child was examined at school age, his or her current exposure to fluoride in water likely matched his or her prenatal exposures. "However, we do not have that kind of a setting in other parts of the world, necessarily, and particularly not in the United States," says Grandjean, who was not involved in the present study.

The authors of the new study[5] used data on 299 mother–child pairs collected through the Early Life Exposures in Mexico to Environmental Toxicants (ELEMENT) Project. Pregnant women recruited at three Mexico City hospitals provided urine samples during gestation, and information was collected regarding their demographics, lifestyle, and medical history. Their children's cognitive ability was evaluated at 4 years of age using the McCarthy Scales of Children's Abilities, and at 6–12 years of age, the children completed an IQ assessment (Wechsler Abbreviated Scale of Intelligence) and provided urine samples.

Higher levels of fluoride in mothers' urine during pregnancy were associated with lower cognitive and IQ scores in their children, but no association was found between the scores and the children's own fluoride levels at 6–12 years of age. Maternal and child urinary levels of fluoride averaged 0.90 and 0.82 mg/L, respectively. The authors estimated that each 0.5-mg/L increase in maternal urinary concentration was associated with an average decrease of 3.15 and 2.50 points in cognitive and IQ scores, respectively. The researchers recommend greater scrutiny of potential adverse effects of fluoride, particularly in pregnant women and in children.

The study's strengths include its longitudinal design, its large sample size, and the assessment of children's neurocognitive development using validated tests. However, the researchers could not rule out the impact of unmeasured variables, including total exposure to other neurotoxicants.

"So little research has been done on the effects of prenatal fluoride on neurodevelopment that it is difficult to know how to interpret the implications of this study," says study coauthor Howard Hu, a professor at the Dalla Lana School of Public Health, University of Toronto. "There are gaps that need to be addressed in order for the scientific world to better interpret the implications of

For people who get enough fluoride from toothpastes and dental treatments, fluoridated drinking water could result in overexposure. However, for people without access to proper dental care, fluoridated water is an important preventive measure. Image: © Ian Cartwright parenting/Alamy Stock Photo.

our study. And, of course, it is just one study, and these results need to be addressed with additional studies of its kind."

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