

## Original Investigation

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# Association Between Maternal Fluoride Exposure During Pregnancy and IQ Scores in Offspring in Canada

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## Key Points

**Question** Is maternal fluoride exposure during pregnancy associated with childhood IQ in a Canadian cohort receiving optimally fluoridated water?

**Findings** In this prospective birth cohort study, fluoride exposure during pregnancy was associated with lower IQ scores in children aged 3 to 4 years.

**Meaning** Fluoride exposure during pregnancy may be associated with adverse effects on child intellectual development, indicating the possible need to reduce fluoride intake during pregnancy.

## Abstract

**Importance** The potential neurotoxicity associated with exposure to fluoride, which has generated controversy about community water fluoridation, remains unclear.

**Objective** To examine the association between fluoride exposure during pregnancy and IQ scores in a prospective birth cohort.

**Design, Setting, and Participants** This prospective, multicenter birth cohort study used information from the Maternal-Infant Research on Environmental Chemicals cohort. Children were born between 2008 and 2012; 41% lived in communities supplied with fluoridated municipal water. The study sample included 601 mother-child pairs recruited from 6 major cities in Canada; children were between ages 3 and 4 years at testing. Data were analyzed between March 2017 and January 2019.

**Exposures** Maternal urinary fluoride ( $MUF_{SG}$ ), adjusted for specific gravity and averaged across 3 trimesters available for 512 pregnant women, as well as self-reported maternal daily fluoride intake from water and beverage consumption available for 400 pregnant women.

**Main Outcomes and Measures** Children's IQ was assessed at ages 3 to 4 years using the Wechsler Primary and Preschool Scale of Intelligence-III. Multiple linear regression analyses were used to examine covariate-adjusted associations between each fluoride exposure measure and IQ score.

**Results** Of 512 mother-child pairs, the mean (SD) age for enrollment for mothers was 32.3 (5.1) years, 463 (90%) were white, and 264 children (52%) were female. Data on  $MUF_{SG}$  concentrations, IQ scores, and complete covariates were available for 512 mother-child pairs; data on maternal fluoride intake and children's IQ were available for 400 of 601 mother-child pairs. Women living in areas with fluoridated tap water ( $n=141$ ) compared with nonfluoridated water ( $n=228$ ) had significantly higher mean (SD)  $MUF_{SG}$  concentrations (0.69 [0.42] mg/L vs 0.40 [0.27] mg/L;  $P=.001$ ; to convert to millimoles per liter, multiply by 0.05263) and fluoride intake levels (0.93 [0.43] vs 0.30 [0.26] mg of fluoride per day;  $P=.001$ ). Children had mean (SD) Full Scale IQ scores of

107.16 (13.26), range 52-143, with girls showing significantly higher mean (SD) scores than boys: 109.56 (11.96) vs 104.61 (14.09);  $P=.001$ . There was a significant interaction ( $P=.02$ ) between child sex and  $MUF_{SG}$  (6.89; 95% CI, 0.96-12.82) indicating a differential association between boys and girls. A 1-mg/L increase in  $MUF_{SG}$  was associated with a 4.49-point lower IQ score (95% CI,  $-8.38$  to  $-0.60$ ) in boys, but there was no statistically significant association with IQ scores in girls ( $B= 2.40$ ; 95% CI,  $-2.53$  to  $7.33$ ). A 1-mg higher daily intake of fluoride among pregnant women was associated with a 3.66 lower IQ score (95% CI,  $-7.16$  to  $-0.14$ ) in boys and girls.

**Conclusions and Relevance** In this study, maternal exposure to higher levels of fluoride during pregnancy was associated with lower IQ scores in children aged 3 to 4 years. These findings indicate the possible need to reduce fluoride intake during pregnancy.