Prenatal maternal and childhood bisphenol A exposure and brain structure and behavior of young children

Melody N. Grohs, Jess E. Reynolds, Jiaying Liu, Jonathan W. Martin, Tyler Pollock, Catherine Lebel, Deborah Dewey and the APrON Study Team

Abstract

Background: Bisphenol A (BPA) is commonly used in the manufacture of plastics and epoxy resins. In North America, over 90% of the population has detectable levels of urinary BPA. Human epidemiological studies have reported adverse behavioral outcomes with BPA exposure in children, however, corresponding effects on children's brain structure have not yet been investigated. The current study examined the association between prenatal maternal and childhood BPA exposure and white matter microstructure in children aged 2 to 5 years, and investigated whether brain structure mediated the association between BPA exposure and child behavior.

Methods: Participants were 98 mother-child pairs who were recruited between January 2009 and December 2012. Total BPA concentrations in spot urine samples obtained from mothers in the second trimester of pregnancy and from children at 3–4 years of age were analyzed. Children participated in a diffusion magnetic resonance imaging (MRI) scan at age 2–5 years (3.7 ± 0.8 years). Associations between prenatal maternal and childhood BPA and children's fractional anisotropy and mean diffusivity of 10 isolated white matter tracts were investigated, controlling for urinary creatinine, child sex, and age at the time of MRI. Post-hoc analyses examined if alterations in white matter mediated the relationship of BPA and children's scores on the Child Behavior Checklist (CBCL).

Results: Prenatal maternal urinary BPA was significantly associated with child mean diffusivity in the splenium and right inferior longitudinal fasciculus. Splenium diffusivity mediated the relationship between maternal prenatal BPA levels and children's internalizing behavior (indirect effect: $\beta = 0.213$, CI [0.0167, 0.564]). No significant associations were found between childhood BPA and white matter microstructure.

Conclusions: This study provides preliminary evidence for the neural correlates of BPA exposure in humans. Our findings suggest that prenatal maternal exposure to BPA may lead to alterations in white matter microstructure in preschool aged children, and that such alterations mediate the relationship between early life exposure to BPA and internalizing problems.

Keywords: Magnetic resonance imaging, White matter, Brain development, Bisphenol A, Behavior, Child Behavior Checklist