Epigenetic mechanism can explain how chemicals in plastic may cause lower IQ levels

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The chemical bisphenol F (found in plastics) can induce changes in a gene that is vital for neurological development. This discovery was made by researchers at the universities of Uppsala and Karlstad, Sweden. The mechanism could explain why exposure to this chemical during the fetal stage may be connected with a lower IQ at seven years of age—an association previously seen by the same research group. The study is published in the scientific journal *Environment International*.

"We've previously shown that bisphenol F (BPF for short) may be connected with children's cognitive development. However, with this study, we can now begin to understand which biological mechanisms may explain such a link, which is unique for an epidemiological study." The speaker is Carl Gustaf Bornehag, Professor and head of Public Health Sciences at Karlstad University. He is the project manager of the Swedish Environmental Longitudinal Mother and Child, Asthma and Allergy (SELMA) study, from which the data were taken.

External factors can cause changes in gene activity through an "epigenetic" mechanism. This means that individual genes are modified by means of "methylation". Increased methylation in a DNA segment makes it more difficult for the cellular machinery to read that specific part. As a result, expression of methylated genes is often impaired.

The scientists measured BPF levels in urine from pregnant women in the first trimester and subsequently monitored their children after birth. DNA methylation was measured in the children at age seven, and their cognitive ability was investigated. Since the fetus comes into contact with the mother's blood via the placenta, it is also exposed to substances in the mother's body.

The analyses demonstrated that in fetuses exposed to higher levels of BPF, methylation increases in a specific part of the GRIN2B gene, which has a key neurological role. Further, higher methylation was associated with lower IQ in the children. However, the study also found that there appears to be a sex difference in these children's susceptibility to BPF. The epigenetic link between BPF and cognition was observed only in boys.

"The fact that we've been able to identify DNA methylation as a potential mechanism behind BPF's effect on IQ adds an important piece of evidence in work to understand how environmental chemicals affect us on a molecular level," says Elin Engdahl, a researcher in environmental toxicology at Uppsala

University and the article's lead author.

In the research group's previous study, they saw that the 25% of seven-year-olds who, during week 10 of the pregnancy, were exposed to the highest maternal levels of bisphenol F had a 2-point decline in full scale IQ compared to the 25% of children exposed to the lowest levels. This is a small difference that is inconspicuous in an individual child but, on the other hand, becomes clear on a population level.

More information: Elin Engdahl et al, DNA methylation at GRIN2B partially mediates the association between prenatal bisphenol F exposure and cognitive functions in 7-year-old children in the SELMA study, *Environment International* (2021). DOI: 10.1016/j.envint.2021.106617