Exposure to BPA substitute causes hyperactivity and brain changes in fish

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A chemical found in many "BPA free" consumer products, known as bisphenol S (BPS), is just as potent as bisphenol A (BPA) in altering brain development and causing hyperactive behavior, an animal study finds. The results will be presented Sunday at the joint meeting of the International Society of Endocrinology and the Endocrine Society: ICE/ENDO 2014 in Chicago.

BPA has been linked to a wide range of hormone disorders, such as obesity, reproductive cancers and, recently, hyperactivity in children born to women exposed to high levels of this substance during the second trimester of pregnancy. Now, this research in fish found that exposure to BPS, a bisphenol compound, led to hyperactive offspring, just as BPA did.

"BPS, termed the safe alternative to BPA, may be equally as harmful to developing brains," said the study's senior investigator, Deborah Kurrasch, PhD, from Canada's University of Calgary. "Society must place increased pressure on decision makers to remove all bisphenol compounds from manufacturing processes."

The study investigated the effects of BPA and BPS on brain development in zebrafish. This fish is developmentally similar to humans, but the embryo grows externally, enabling researchers to see development of the offspring.

A PhD student in Kurrasch's lab, Cassandra Kinch, exposed zebrafish embryos during the period similar to the second trimester to the exact chemical concentration of BPA found in a local major water source, the Oldman River in Alberta, Canada. This concentration translated to a low dose of BPA for the embryos. By labeling some 5-day-old embryos with molecular markers, she monitored development of the hypothalamus, a powerful region of the brain that controls release of hormones in fish and humans. She counted the number of neurons, or nerve cells, in that brain region and compared it with the number of neurons from fish embryos without BPA exposure.

At the peak time of neuronal birth, the number of neurons in BPA-exposed fish rose 170 percent compared with unexposed fish, Kurrasch stated. In similar experiments using BPS, the number of neurons in exposed fish increased 240 percent. These results, she explained, suggest that BPA and BPS could lead to altered brain connections and might explain the hyperactivity they observed in another experiment. Specifically, the research team used movement tracking software to evaluate behavioral changes in young fish and found that fish exposed during brain development to either BPA or BPS were hyperactive, but unexposed fish were not.

Researchers have thought BPA causes harmful effects by mimicking the female hormone estrogen. However, the Kurrasch lab found another likely cause. They exposed another group of zebrafish to BPA plus various drugs that each block distinct hormone signals. Rather than influencing estrogen signaling pathways, as previously hypothesized, BPA appeared to stimulate neuronal birth by mimicking the male hormone testosterone, which then induced aromatase B, a brain-specific protein recently reported to control the birth of neurons and a key enzyme for estrogen synthesis (production), according to Kurrasch.

"These data provide a new avenue of research to investigate the recent rise in hormone disorders," she said.

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