

Breastfeeding moms' exposure to nicotine linked to infant skull defect

April 27 2020, by Emily Caldwell



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Lactating mothers who use e-cigarettes or nicotine replacement therapies may be putting their breastfed babies at risk for skull defects, a new study in animals suggests.

Cigarette smoking has already been linked to increased risk for these abnormalities in previous research. This study tested the effects of nicotine alone on [head](#) and face development.

Researchers added nicotine to the drinking water of adult female mice that were nursing litters of newborn pups. The [nicotine exposure](#) was the equivalent of about one-half to a full pack of cigarettes per day.

Scientists found in 15-day-old pups that the skull joints across the top of their heads were narrowed, putting them on a path to fuse earlier than normal. Because mouse pups at this age don't drink water, breast milk was the only possible source of their nicotine exposure.

In human babies, this skull abnormality not only changes the shape of the head but can require neurosurgery to make room for the brain to grow.

The study builds upon previous work by the Ohio State University researchers that showed in mice that nicotine exposure during pregnancy altered offspring's craniofacial growth and development.

"We knew based on previous data in pregnancy that we'd see some changes, but we were a bit taken aback to find there were discernible differences when the nicotine exposure was occurring only during lactation," said James Cray, associate professor of anatomy in Ohio State's College of Medicine and senior author of the study.

"Our data suggest that nicotine alone can alter development of the head and face. That means mothers who vape are likely exposing their unborn children or infants to an amount of nicotine and its metabolites that can disturb growth in the same way cigarettes can."

The research was scheduled to be presented at the April 2020 American Association for Anatomy meeting held as part of the Experimental

Biology conference, which was canceled because of the COVID-19 pandemic. In lieu of that presentation, the abstract was published in *The FASEB Journal*.

The disorder seen in these studies is called craniosynostosis, which results from the premature closure of joints, or sutures, that connect sections of the skull and remain flexible early in life as the brain continues to grow. One or more of the sutures can be affected.

"Where there is supposed to be a growth site to allow for expansion of the brain, the joints are locked together. The brain can't push those skull sections apart, so it grows in other directions," Cray explained.

The Centers for Disease Control and Prevention estimates that 1 in every 2,500 babies is born with craniosynostosis. A definitive cause is unknown, but the disorder has been linked in studies to genetic mutations and mothers' use of certain medications.

Craniosynostosis can alter the shape of the head and impair the development of the eyes and vital organs and, if not repaired in surgery, may lead to developmental delays. Symptoms include altered head shape, projectile vomiting, poor feeding, high-pitched crying and sleepiness caused by increased pressure on the brain. Children with the disorder who don't need surgery live normal lives with uncorrected abnormalities.

Based on previous work, Cray and colleagues targeted the nicotine dose in this study at 100 micrograms per milliliter, expecting mice to drink 3 to 5 milliliters of water per day. The researchers confirmed the mouse moms' level of exposure by measuring chemicals that are metabolites of nicotine in their blood.

When the pups were 15 days old, which roughly equates to age 1-2 years

in humans, the scientists used micro-CT scanning to measure their heads. They found abnormalities in development of the pups' coronal sutures, joints that span the top of the head from ear to ear.

Cray is continuing this work, next planning to vaporize nicotine in mouse studies to mimic the effects of [e-cigarettes](#) on head and face development in offspring. His lab is also studying nicotine's effects on bone cells, looking for potential mechanisms to explain the damage. Early results suggest nicotine increases cell division and also puts so much stress on cells in the skull that they prematurely discard components that contribute to their normal function.

"The broader implication of this work, simply put, is that nicotine cannot be viewed as a relatively safe chemical that acts only on addiction," Cray said. "We know a lot as a scientific community about cigarettes. But we don't know as much about the components in cigarettes. The need to better understand the effects of [nicotine](#) alone is our specific aim."

More information: amr mohi et al. Maternal Nicotine Exposure During Lactation Alters Craniofacial Development. *The FASEB Journal*
First published:16 April 2020 doi.org/10.1096/fasebj.2020.34.s1.02917

Provided by The Ohio State University

Citation: Breastfeeding moms' exposure to nicotine linked to infant skull defect (2020, April 27) retrieved 10 May 2024 from <https://medicalxpress.com/news/2020-04-breastfeeding-moms-exposure-nicotine-linked.html>

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