Prenatal nicotine exposure may lead to ADHD in future generations

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Prenatal exposure to nicotine could manifest as attention deficit hyperactivity disorder in children born a generation later, according to a new study by Florida State University College of Medicine researchers.

Professors Pradeep G. Bhide and Jinmin Zhu have found evidence that ADHD associated with nicotine can be passed across generations. In other words, your child's ADHD might be an environmentally induced health condition inherited from your grandmother, who may have smoked cigarettes during pregnancy a long time ago. And the fact that you never smoked may be irrelevant for your child's ADHD.

The researchers' findings are published in the current issue of *The Journal of Neuroscience*.

"What our research and other people's research is showing is that some of the changes in your genome—whether induced by drugs or by experience—may be permanent and you will transmit that to your offspring," said Bhide, chair of developmental neuroscience and director of the Center for Brain Repair at the College of Medicine.

Bhide and Zhu, assistant professor of biomedical sciences, used a mouse model to test the hypothesis that hyperactivity induced by prenatal nicotine exposure is transmitted from one generation to the next. Their data demonstrated that there is a transgenerational transmission via the maternal, but not the paternal, line of descent.

"Genes are constantly changing. Some are silenced and others are expressed, and that happens not only by hereditary mechanisms, but because of something in the environment or because of what we eat or what we see or what we hear," Bhide said. "So the genetic information that is transmitted to your offspring is qualitatively different than the information you got from your parents. This is how things change over time in the population."

Building on recent discoveries about how things like stress, fear or hormonal imbalance in one individual can be passed along to the next generation, Bhide and Zhu were curious about a proven link between prenatal nicotine exposure and hyperactivity in mice.

Their work at the Center for Brain Repair has included extensive research around ADHD, a neurobehavioral disorder affecting about 10 percent of children and 5 percent of adults in the United States. Researchers have struggled to produce a definitive scientific explanation for a spike in ADHD diagnoses in the last few decades.

"Some reports show up to a 40 percent increase in cases of ADHD—in one generation, basically," Bhide said. "It cannot be because a mutation

occurred; it takes several generations for that to happen."

One possible contributing factor, though unproven, is that the current spike in ADHD cases correlates in some manner to an increase in the number of women who smoked during pregnancy as cigarettes became fashionable in the United States around the time of World War II and in the decades that followed.

"Other research has shown a very high correlation between heavy smoking during pregnancy and the incidence of kids with ADHD," Bhide said.

"What's important about our study is that we are seeing that changes occurring in my grandparents' genome because of smoking during pregnancy are being passed to my child. So if my child had ADHD it might not matter that I did not have a disposition or that I never smoked."

Bhide cautions that the work, though conclusive, is based on a study in mice, which have served as a proxy for human phenotypes.

"It's not that every child born to a mother who smokes has ADHD, and it also isn't true that every person with ADHD will transmit the genetic material responsible," he said.

"But our work has opened up new possibilities. The next question is how does transmission to future generations happen? What is the mechanism? And the second question is, if the individual is treated successfully would that stop the transmission to future generations?"

Provided by Florida State University