

New study examines the way estrogen affects methamphetamine addiction

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Dr. Antonieta Lavin, an associate professor in the neuroscience department at the Medical University of South Carolina who worked on the study with fellow researcher Carmela Reichel, is pictured above in her lab. Credit: Sarah Pack, Medical University of South Carolina

Male rats have held steady as the focus of most addiction studies in the past. But as the field begins to take female rats into account, scientists see that drugs like methamphetamine affect the sexes differently, suggesting the basis for a change in addiction treatment.

"The [brain changes](#) when you've been addicted to methamphetamine," said Antonieta Lavin, an associate professor in the neuroscience department at the Medical University of South Carolina who worked on the study with fellow researcher Carmela Reichel. "But we have limited information on how our sex hormones affect that [addiction](#)."

In a paper published January 10, 2019 in *eNeuro*, MUSC researchers suggest that the brain of a female rat responds differently to drugs like methamphetamine and that these differences may be due to the presence of estrogen and its effect

on addiction.

According to the Centers for Disease Control and Prevention, methamphetamine alone is responsible for 11,000 deaths in the United States each year, and with more than 70,000 total drug-related deaths in 2017, researchers like Lavin and Reichel are working to improve treatment for those with substance use disorder.

As a stimulant, methamphetamine increases activity in certain areas of the brain, such as the [prefrontal cortex](#). And according to the American Addiction Centers, the drug releases dopamine in the brain, which gives the user a sense of pleasure. In addition to this rewarding feeling, dopamine also controls a person's motivation, movement, memory and learning.

By consistently releasing excess dopamine, methamphetamine users train the brain to expect and crave heightened levels of this neurotransmitter, and the same happened with the male and female rats in this study.

Researchers gave their test subjects the ability to self-administer methamphetamine, meaning that the rats were able to control how much of the drug they consumed and how often they took it. Female rats consistently took more methamphetamine more often during the first six hours of their addiction, and the researchers involved suggest that this window may be crucial in explaining why female addiction is so powerful.

Over time, methamphetamine addiction alters the way in which signals are carried throughout the brain, specifically targeting the synapses in the prefrontal cortex, where the brain controls decision-making and learning.

When MUSC researchers examined the prefrontal cortices of both male and female rats addicted and not addicted to [methamphetamine](#), they found that

the synaptic response in this area was different between males and females as well as between the addicted and non-addicted animals. For example, Lavin and Reichel found that [female rats](#) showed lower resting activity than [male rats](#) but then experienced a faster rise in their brain's synaptic activity after taking the drug. This stronger response was then followed by a faster fall once the drug wore off.

This synaptic difference between males and females suggests that sex hormones play a larger role than previously thought in how [rats](#), and potentially humans, process drugs and could lead to more male- and female-specific substance abuse disorder treatment in the future.

"Next, I would like to study how meth addiction changes throughout the different phases of the female cycle," said Lavin. "This insight would help us improve treatment for women suffering from substance use disorder."

More information: Jose Ignacio Pena-Bravo et al. Methamphetamine Self-Administration Elicits Sex-Related Changes in Postsynaptic Glutamate Transmission in the Prefrontal Cortex, *eneuro* (2019). [DOI: 10.1523/ENEURO.0401-18.2018](https://doi.org/10.1523/ENEURO.0401-18.2018)

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