MedicalXpress

Nicotine withdrawal weakens brain connections tied to self-control over cigarette cravings

March 12 2014

People who try to quit smoking often say that kicking the habit makes the voice inside telling them to light up even louder, but why people succumb to those cravings so often has never been fully understood. Now, a new brain imaging study in this week's *JAMA Psychiatry* from scientists in Penn Medicine and the National Institute on Drug Abuse (NIDA) Intramural Research Program shows how smokers suffering from nicotine withdrawal may have more trouble shifting from a key brain network—known as default mode, when people are in a so-called "introspective" or "self-referential" state— and into a control network, the so-called executive control network, that could help exert more conscious, self-control over cravings and to focus on quitting for good.

The findings help validate a neurobiological basis behind why so many people trying to quit end up relapsing—up to 80 percent, depending on the type of treatment—and may lead to new ways to identify smokers at high risk for relapse who need more intensive smoking cessation therapy.

The brain imaging study was led by researchers at University of Pennsylvania's new Brain and Behavior Change Program, led by Caryn Lerman, PhD, who is also the deputy director of Penn's Abramson Cancer Center, and Elliot Stein, PhD, and collaborators at NIDA. They found that smokers who abstained from cigarettes showed weakened interconnectivity between certain large-scale networks in their brains:

the default mode network, the executive control network, and the salience network. They posit that this weakened connectivity reduces smokers' ability to shift into or maintain greater influence from the executive control network, which may ultimately help maintain their quitting attempt.

"What we believe this means is that smokers who just quit have a more difficult time shifting gears from inward thoughts about how they feel to an outward focus on the tasks at hand," said Lerman, who also serves as the Mary W. Calkins professor in the Department of Psychiatry. "It's very important for people who are trying to quit to be able to maintain activity within the control network— to be able to shift from thinking about yourself and your inner state to focus on your more immediate goals and plan."

Prior studies have looked at the effects of nicotine on brain interconnectivity in the resting state, that is, in the absence of any specific goal directed activity. This is the first study, however, to compare resting brain connectivity in an abstinent state and when people are smoking as usual, and then relate those changes to symptoms of craving and mental performance.

For the study, researchers conducted brain scans on 37 healthy smokers (those who smoke more than 10 cigarettes a day) ages 19 to 61 using functional magnetic resonance imaging (fMRI) in two different sessions: 24 hours after biochemically confirmed abstinence and after smoking as usual.

Imaging showed a significantly weaker connectivity between the salience network and default mode network during abstinence, compared with their sated state. Also, weakened connectivity during abstinence was linked with increases in smoking urges, negative mood, and withdrawal symptoms, suggesting that this weaker internetwork connectivity may

make it more difficult for people to quit.

Establishing the strength of the connectivity between these large-scale brain networks will be important in predicting people's ability to quit and stay quit, the authors write. Also, such connectivity could serve as a clinical biomarker to identify smokers who are most likely to respond to a particular treatment.

"Symptoms of withdrawal are related to changes in smokers' brains, as they adjust to being off of nicotine, and this study validates those experiences as having a biological basis," said Lerman. "The next step will be to identify in advance those smokers who will have more difficultly quitting and target more intensive treatments, based on brain activity and network connectivity."

Provided by University of Pennsylvania School of Medicine