What smoking marijuana does to the brain

By Dennis Thompson
CBSNews.com | November 11, 2014

Long-term marijuana use appears to alter a person's brain, causing one region associated with addiction to shrink and forcing the rest of the brain to work overtime to compensate, a new study reports.

MRI scans revealed that people who use pot for years have a smaller-than-usual orbitofrontal cortex, a region in the frontal lobes of the brain that is involved in decision-making and assessing the expected rewards or punishments of an action, said study author Francesca Filbey, from the Center for BrainHealth at The University of Texas at Dallas.

These regular and long-term users of the drug also experienced increased connectivity between regions of the brain compared with non-users, as the brain rewires itself to make up for the shrinkage in the frontal lobes, Filbey, director of the center's Cognitive Neuroscience Research in Addictive Disorders, added.

"The changes in connectivity may be considered a way of compensating for the reduction in volume," she said. "This may explain why chronic users appear to be doing fine, even though an important region of their brain is smaller in terms of volume."

Pro-marijuana advocates questioned the usefulness of the study, noting that the researchers did not link brain changes to any differences in day-to-day activity.

"Investigators in this study failed to assess whether any of these differences are positively associated with any measurable adverse performance outcomes, such as cognitive [mental] performance or quality of life," said Paul Armentano, deputy director of the nonprofit National Organization for the Reform of Marijuana Laws (NORML).

"It may be that these cannabis users are functioning in their daily lives in a manner that is indistinguishable from controls, in which case these imaging differences may hold little, if any, real-world significance," Armentano said.

The study was published Nov. 10 in Proceedings of the National Academy of Sciences.

The state-level movement to legalize marijuana in the United States has drawn increasing attention to studies on the safety of the drug. Voters in Oregon and Washington, D.C., recently legalized marijuana sales and possession, following last year's legalization votes by Washington and Colorado.

For their research, the Texas team studied 48 adult marijuana users, comparing their brain scans to those of 62 non-users. On average, the marijuana users in the study consumed the drug three times a day, and had been using it for about a decade.

The changes in the orbitofrontal cortex of the marijuana users could be taking place as a result of the brain cutting back on its receptors for THC, the main psychoactive agent in the marijuana plant, Filbey said.

"The more THC is introduced in the system, the brain responds by reducing the number of receptors," she said.

The researchers also found that the brains of marijuana users, compared with non-users, seemed to have increased structural integrity and the different areas of the brain appeared to be activating and responding in greater synchronicity.

That enhanced connectivity did not appear to last, however, in the long term.

"The gains in connectivity following onset of use does begin to decrease after six to eight years," Filbey said. "It's not so much that the increase in brain connectivity is there and remains that way through their lifetimes or through their period of use."

Most disturbing to Filbey was the fact that these changes were more pronounced in people who started using pot at an early age.

"Our youngest onset of use was 14 years of age, and the difference between 14 and people who started using in their later 20s was really striking in terms of degree," Filbey said. "These changes seem to be far more significant the earlier you start using marijuana, and early adolescent use leads to greater changes."

However, the researchers could not draw a correlation between any IQ deficits and the shrunken regions of the brain.

"The fact that we have to go to this much trouble to find something, anything, awry with the brains of the users is probably the most revealing thing about the whole study," said Mitch Earleywine, the chairman of NORML and a psychology professor at the State University of New York at Albany. "Long-term cannabis users don't seem to show genuine cognitive deficits despite these minor brain structure anomalies."

Dr. Scott Krakower, assistant unit chief of psychiatry at Zucker Hillside Hospital in Glen Oaks, N.Y., said the study adds to "evidence supporting the thought that marijuana may be deleterious to humans, particularly with long-term consumption."

Previous studies have shown that marijuana use can affect IQ, motivation and ability to plan or make decisions, Krakower said, and that these effects are likely to grow more pronounced as newer forms of marijuana with greater levels of THC hit the market.

"As resilient as our bodies are, your body's not going to be able to keep up with that cumulative exposure over the long run," Krakower added.