Cannabis Use Is Quantitatively Associated with Nucleus Accumbens and Amygdala Abnormalities in Young Adult Recreational Users

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Abstract

Marijuana is the most commonly used illicit drug in the United States, but little is known about its effects on the human brain, particularly on reward/aversion regions implicated in addiction, such as the nucleus accumbens and amygdala. Animal studies show structural changes in brain regions such as the nucleus
accumbens after exposure to Δ9-tetrahydrocannabinol, but less is known about cannabis use and brain
morphometry in these regions in humans. We collected high-resolution MRI scans on young adult
recreational marijuana users and nonusing controls and conducted three independent analyses of
morphometry in these structures: (1) gray matter density using voxel-based morphometry, (2) volume
(total brain and regional volumes), and (3) shape (surface morphometry). Gray matter density analyses
revealed greater gray matter density in marijuana users than in control participants in the left nucleus
accumbens extending to subcallosal cortex, hypothalamus, sublenticular extended amygdala, and left
amygdala, even after controlling for age, sex, alcohol use, and cigarette smoking. Trend-level effects were
observed for a volume increase in the left nucleus accumbens only. Significant shape differences were
detected in the left nucleus accumbens and right amygdala. The left nucleus accumbens showed salient
exposure-dependent alterations across all three measures and an altered multimodal relationship across
measures in the marijuana group. These data suggest that marijuana exposure, even in young recreational
users, is associated with exposure-dependent alterations of the neural matrix of core reward structures and
is consistent with animal studies of changes in dendritic arborization.

- cannabis
- gray matter density
- marijuana
- multimodal imaging
- reward
- topology/shape

- Received November 6, 2013.
- Revision received March 9, 2014.
- Accepted March 11, 2014.