Association of Cannabis Use During Adolescence With Neurodevelopment

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Animal studies have shown that the adolescent brain is sensitive to disruptions in endocannabinoid signaling, resulting in altered neurodevelopment and lasting behavioral effects. However, few studies have investigated ties between cannabis use and adolescent brain development in humans. Here, we examined the degree to which magnetic resonance (MR) imaging–assessed cerebral cortical thickness development is associated with cannabis use in a longitudinal sample of adolescents.

Methods: Data were obtained from the community-based IMAGEN cohort study, conducted across 8 European sites. A total of 799 IMAGEN participants were identified who reported being cannabis naive at study baseline and had behavioral and neuroimaging data available at baseline and 5-year follow-up. Cannabis use was assessed at baseline and 5-year follow-up with the European School Survey Project on Alcohol and Drugs. Anatomical MRIs were acquired with a three-dimensional T1-weighted magnetization prepared gradient echo sequence. Quality-controlled native MR images were processed through the CIVET pipeline (version 2.1.0).

Results: At 5-year follow-up, cannabis use (from 0 to >40 uses) was negatively associated with thickness in prefrontal cortices (n = 799; 450 females, mean age at follow-up = 18.98 years). There were no significant associations between lifetime cannabis use at 5-year follow-up and baseline cortical thickness, suggesting that the observed neuroanatomical differences did not precede initiation of cannabis use. Longitudinal analysis revealed that age-related cortical thinning was qualified by cannabis use in a dose-dependent fashion such that greater use, from baseline to follow-up, was tied to increased thinning in predominantly prefrontal regions. Moreover, the spatial pattern of cannabis-related thinning was associated with age-related thinning in this sample (r = 0.540, p < .001), and a PET-assessed CB1 receptor-binding map derived from a separate sample of participants (r = -0.189, p < .001). Analysis revealed that thinning in right prefrontal cortices, from baseline to follow-up, was associated with attentional impulsiveness at follow-up.

Discussion: This investigation represents the largest longitudinal neuroimaging study of cannabis use to date. Results suggest that cannabis use during adolescence is linked to altered

neurodevelopment, particularly in cortices rich in CB1 receptors and undergoing the greatest age-related thickness change in middle-to-late adolescence.

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