



Editorial

Elucidating the Impact of Adolescent Marijuana Use



The term “marijuana” refers to the crude drug consisting of dry, shredded components of several *Cannabis* plant varieties, including the 2 most common varieties, *Cannabis indica* and *Cannabis sativa* [1]. Marijuana has gone through multiple phases of legality in the United States, though it has been illegal under federal law since the 1970 enactment of the Federal Controlled Substance Act, where it is classified as a Schedule 1 drug (i.e., no currently accepted medical use, high potential for abuse, and lack of accepted safety data). Despite its federal illegality, many states have enacted more permissive marijuana laws for medicinal and recreational use.

As of April 1, 2018, 30 states, the District of Columbia, Guam, and Puerto Rico have enacted medical marijuana laws (MMLs), a heterogeneous range of provisions effectively allowing patients with specified conditions to purchase, possess, cultivate, and consume marijuana for medicinal purposes. Nine states and District of Columbia have enacted recreational marijuana laws (RMLs), a separate set of provisions effectively allowing adults ≤ 21 to purchase, possess, cultivate, and consume marijuana for recreational purposes. These state-level statutory changes have been fervently debated, and there has been concern that any permissive change in the legality of marijuana may affect the prevalence of use in adolescents, as well as other adverse consequences.

Marijuana is the most used illicit drug among adolescents in the United States and the leading cause for entering substance use/abuse treatment, with use typically initiated in middle to late adolescence and peaking in the early and middle 20s [2,3]. Marijuana use during the critical period of neural development in adolescence may interrupt maturational processes, [4] with research suggesting that the severity of effects on cognitive development is dependent on the age of initiation [4–6]. Further, there is evidence that adolescents who use marijuana are more likely to partake in other risky behaviors, including risky sexual behaviors; use of alcohol and cocaine; driving while intoxicated or riding with a driver who has been drinking; poorer educational outcomes, truancy, and future unemployment; and mental health problems [7–15].

Monitoring in the Future, an ongoing national school-based surveillance system, surveys varying cohorts of U.S. adolescents annually and reports that in 2017, 10.1% of 8th graders, 25.5% of 10th graders, and 37.1% of 12th graders reported past-year marijuana use. Marijuana use significantly increased for the first time in 7 years in 2017 among the combined sample of 8th, 10th, and 12th graders. This increase stands in contrast to the overall secular

decreases in both alcohol and tobacco use, as well as declines in other common risk-taking behaviors among adolescents [16,17].

The majority of current studies have assessed changes in adolescent marijuana use using national and state representative samples of U.S. adolescents' post-MML enactment and/or implementation. A recently published systematic review and meta-analysis of studies assessing MMLs and changes in adolescent marijuana use reported that none of the 11 studies using large national surveys found significant estimates of pre–post MML changes in adolescent marijuana use prevalence compared with non-MML state counterparts [18]. Research is just starting to assess the heterogeneity inherent in MML design to assess whether more permissive provisions have effects on adolescent marijuana use [19–21].

Research assessing RMLs is still in its nascent stage. Preliminary studies have assessed marijuana use and varying outcomes post-RML enactment and/or implementation in Colorado and Washington, the first 2 states to enact RMLs in 2012. One study using a small sample in Washington found higher nonsignificant marijuana use prevalence rates among adolescents after the transition from MML-only to having both MML and RML [22]. Another study assessing the frequency and consequences of adolescent use in a sample of participants in a school-based, substance use intervention in Washington from 2010 to 2015 found relatively equal marijuana use between the pre- and post-RML groups. However, findings indicated a significant positive correlation between marijuana-related consequences and perceived risk post-RML [23].

The potential increase in marijuana use is only 1 possible adverse outcome of more permissive marijuana laws. Important research gaps remain, including but not limited to changes in perception of harm, social norms, modes of consumption, marijuana use disorders (MUDs), marijuana treatment admissions, mental health disorders and suicidality, polysubstance use, and associated risk-taking behavior. Additionally, marijuana legalization has created new modes of consumption (i.e., edibles, vaporizing, etc.), which may be more alluring to adolescents, and advancements in cultivation have produced marijuana products with much higher levels of tetrahydrocannabinol.

In this issue of the Journal, a novel study by Wang et al. examines a more serious adverse effect of marijuana legalization that survey data are not able to assess adolescent marijuana-associated emergency department and urgent care visits in Colorado from 2005 to 2015, a time period following both medical and

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recreational marijuana legalization [24]. The authors report a significant 10-year increase in adolescent marijuana-associated emergency/urgent care visits ($p < .001$) with discharge codes showing marijuana abuse (62%), unspecified episodic mood disorder (20%), alcohol abuse (15%), and depressive disorder (14%).

These findings are important in light of what current research has shown in regard to adolescent MUDs, polysubstance use, and mental health. In a U.S. representative sample of 12–14-year olds from 2005 to 2014, Forman-Hoffman et al. report that among the 5.5% of lifetime marijuana users, 17.4% met criteria for past-year MUD [25]. Richter et al. found MUD rates in adolescents were double that of their adult counterparts, and a significant proportion of adolescent marijuana users is at risk for having an MUD even at relatively low levels of use [26]. Young age, black race/ethnicity, greater intensity of use, current tobacco/nicotine use, and alcohol and other drug use disorders were associated with increased odds of an MUD. A literature review found that longitudinal research suggests that *Cannabis* use predicts the development of anxiety disorders, depression, suicidal ideation, certain personality disorders, and interpersonal violence; associations were stronger in adolescents relative to adults, with younger age of initiation increasing the risk of developing mental health disorders [27].

Research shows that alcohol and drug use disorders are highly comorbid, and alcohol and marijuana use is the most prevalent [28]. Adolescents may use drugs concurrently or consecutively for a variety of reasons, including: the cumulative or complementary effect of 2 drugs, drug availability, price, changes in legality, or social desirability [29]. Two thirds of adolescents who report use of an addictive substance are lifetime polysubstance users [30]. Chun et al. report that, compared with adolescents who only use alcohol, adolescents who use both alcohol and marijuana have higher rates of smoking and binge drinking, consume more drinks per sitting, have more externalizing behavior problems, and report greater peer tolerance of substance use [31].

As Wang et al. suggest, it is imperative that multiple modalities of surveillance are used to understand more comprehensively the impact of the evolving and heterogeneous state-level marijuana law landscape on adolescent cohorts. Survey data are able to monitor changes in use patterns and perceptions of harm, among other important marijuana indicators, but may not be able to adequately assess the spectrum of potentially more harmful effects, such as emergency/urgent care visits. These results elucidate the need to better understand adolescent MUDs, polysubstance use, and co-occurring substance use and mental health disorders.

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