Drug and Alcohol Dependence 159 (2016) 158–165

Contents lists available at ScienceDirect

Drug and Alcohol Dependence

journal homepage: www.elsevier.com/locate/drugalcdep

Full length article

Marijuana use trajectories during college predict health outcomes nine years post-matriculation

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ARTICLE INFO

Article history:
Received 17 August 2015
Received in revised form
25 November 2015
Accepted 11 December 2015
Available online 23 December 2015

Keywords:
Cannabis
Health care utilization
Health outcomes
Longitudinal studies
Mental health
Physical health

ABSTRACT

Background: Several studies have linked marijuana use with a variety of health outcomes among young adults. Information about marijuana's long-term health effects is critically needed.
Methods: Data are from a ten-year study of 1253 young adults originally recruited as first-year college students and assessed annually thereafter. Six trajectories of marijuana use during college (Non-Use, Low-Stable, Early-Decline, College-Peak, Late-Increase, Chronic) were previously derived using latent variable growth mixture modeling. Nine health outcomes assessed in Year 10 (modal age 27) were regressed on a group membership variable for the six group trajectories, holding constant demographics, baseline health status, and alcohol and tobacco trajectory group membership.
Results: Marijuana trajectory groups differed significantly on seven of the nine outcomes (functional impairment due to injury, illness, or emotional problems; psychological distress; subjective well-being; and mental and physical health service utilization; all *ps* < .001), but not on general health rating or body mass index. Non-users fared better than the Late-Increase and Chronic groups on most physical and mental health outcomes. The declining groups (Early-Decline, College-Peak) fared better than the Chronic group on mental health outcomes. The Late-Increase group fared significantly worse than the stable groups (Non-Use, Low-Stable, Chronic) on both physical and mental health outcomes.
Conclusions: Even occasional or time-limited marijuana use might have adverse effects on physical and mental health, perhaps enduring after several years of moderation or abstinence. Reducing marijuana use frequency might mitigate such effects. Individuals who escalate their marijuana use in their early twenties might be at especially high risk for adverse outcomes.

1. Introduction

Marijuana use is highly prevalent, with approximately one in ten U.S. adults and one-third of college students having used during the past year (Johnston et al., 2014; Substance Abuse and Mental Health Services Administration (SAMHSA), 2014). Recent legislative trends toward decriminalization and legalization have been accompanied by declining perceptions of marijuana's harmfulness (Johnston et al., 2014; SAMHSA, 2014). Given that emerging adulthood is a critical developmental stage with respect to identity exploration and establishing long-term adult roles, the consequences of marijuana use during this period could be substantial and enduring (Arnett, 2005). Young adulthood is also the peak developmental period for marijuana use and related problems (SAMHSA, 2014).

Public perceptions notwithstanding, abundant research evidence from both cross-sectional and longitudinal studies supports the association between marijuana use and a variety of psychosocial and health outcomes, especially when use begins early or is frequent, although not all studies have controlled for potential confounds such as alcohol and tobacco use (for reviews, see Hall, 2015; Joshi et al., 2014; Thomas et al., 2014). For example, marijuana use has been linked to psychosis (Di Forti et al., 2015, 2009; Fergusson et al., 2005; Hall, 2015; Henquet et al., 2005; Moore et al., 2007; van Os et al., 2002), bipolar disorder (Lagerberg et al., 2014), and

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http://dx.doi.org/10.1016/j.drugalcdep.2015.12.009
0376-8716/

major depression (Juon et al., 2011; Lynne-Landsman et al., 2010). The apparent dose-response relationship is particularly concerning given the increasing potency of marijuana during the past several decades (Mehmedic et al., 2010). Marijuana's physical health effects include respiratory outcomes such as chronic bronchitis, airway inflammation, and decreased pulmonary function (Joshi et al., 2014; Tashkin, 2013), as well as increased risk for cardiovascular disease and acute cardiac events (Jouanjus et al., 2014; Mittleman et al., 2001; Mukamal et al., 2008; Thomas et al., 2014). Accordingly, some evidence indicates that health care utilization is higher for frequent marijuana users than non-users, namely for respiratory illness and injuries, even when excluding tobacco smokers (Polen et al., 1993).

Studies using group-based trajectory modeling can provide a more complete picture of the association between marijuana use patterns during adolescence and health outcomes in young adulthood. Despite methodological differences (e.g., frequency measures, age ranges, number of trajectory groups), certain commonalities emerge from the existing research utilizing this method. Most include a group that abstains from marijuana use, a group that consistently uses infrequently, and a group that consistently uses at high frequencies (Brook et al., 2013; Caldeira et al., 2012; Homel et al., 2014; Schulenberg et al., 2005). Many studies also identified groups with increasing or decreasing frequency of use over time (Brook et al., 2013; Caldeira et al., 2012; Ellickson et al., 2004; Schulenberg et al., 2005) or with different ages of onset (Flory et al., 2004).

In these studies, the trajectory groups that abstain from marijuana use throughout adolescence and young adulthood generally fare best in terms of education, employment, health, and social outcomes (Brook et al., 2013; Caldeira et al., 2012; Ellickson et al., 2004; Flory et al., 2004; Homel et al., 2014; Schulenberg et al., 2005). In contrast, the chronic trajectory groups generally exhibit poor outcomes related to employment and finances (Brook et al., 2013), education (Homel et al., 2014), alcohol and tobacco use (Schulenberg et al., 2005), and mental health (Brook et al., 2011; Caldeira et al., 2012). Even among an "early high" trajectory group (i.e., frequent use at age 13 that declined and stabilized by age 18), self-ratings of overall health at age 29 were significantly lower relative to the other trajectory groups (Ellickson et al., 2004). Nevertheless, few studies have examined young adult outcomes related to physical and mental health, and more comprehensive measures of these outcomes are needed. Additionally, previous studies have been limited in their ability to account for alcohol and tobacco use, which covary with marijuana use (Jackson et al., 2008).

The present study builds on our team's prior work examining health outcomes in young adulthood in relation to marijuana use trajectories during college (Caldeira et al., 2012). Among a sample of 1253 college students studied over seven years, we identified six distinct trajectories of marijuana use frequency spanning the first six years of the study (see Fig. 1), which – as noted above – were significantly associated with several health outcomes in the seventh year, even after adjusting for baseline health status, demographics, alcohol use, and tobacco use. The present study aims to extend this prior research to evaluate what, if any, relationship might exist between marijuana use trajectory group membership during college and self-reported health outcomes measured in Year 10 (i.e., nine years post-matriculation). An important goal of this work was to replicate our earlier models to understand whether the observed associations with certain health outcomes would persist as participants approached age 30. We hypothesized that marijuana trajectory group membership would be significantly associated with health outcomes in Year 10, even after accounting for alcohol and tobacco use, demographics, and baseline health status.

2. Methods

2.1. Study design

Data were collected as part of the College Life Study, which followed a cohort of 1253 individuals originally recruited in 2004 as incoming freshmen at one large public university (Arria et al., 2008; Vincent et al., 2012). After screening the entire incoming class of students ages 17–19 (82% response rate), a sample was selected for longitudinal follow-up, with oversampling of individuals who used an illicit drug at least once during high school. Baseline and annual follow-up assessments through Year 8 included a personal interview and self-administered questionnaires. Follow-up assessments were scheduled throughout the academic year (i.e., September through May) to coincide approximately with each individual's baseline anniversary. A 30-min web-based assessment was conducted in Year 10. Participants were paid for each assessment. Follow-up rates were excellent, with 74% of the original cohort completing the Year 10 assessment. The study was approved by the university's IRB. Informed consent was obtained. Interviewers were trained extensively in procedures for maintaining confidentiality.

2.2. Participants

The analysis sample consisted of the 932 individuals (43% male, 73% white, 5% Hispanic) who completed the Year 10 assessment (modal age 27). Attrition was significantly higher for men than women (34% vs. 18%, $p < .001$) but did not differ significantly by race, parental education, or marijuana trajectory group membership. Mean neighborhood income of family of origin was slightly higher among non-responders (76.7 K vs. 7. K, $p < .05$).

2.3. Measures

2.3.1. Marijuana, alcohol, and tobacco trajectory groups. As described by Caldeira et al. (2012), latent variable growth mixture modeling was used to identify six distinct trajectories of marijuana use, based on the annual observations of past-month marijuana use frequency from Year 1 (2004–2005) through Year 6 (2009–2010) of the study (see Fig. 1). Similar procedures were used to identify seven alcohol trajectory groups and five tobacco trajectory groups. For each substance, models were fit assuming a Poisson distribution using PROC TRAJ (Jones and Nagin, 2007) in SAS 9.2 (SAS Institute Inc., 2008). Three separate categorical variables were created to represent trajectory group membership for marijuana, alcohol, and tobacco use frequency, respectively (see Caldeira et al., 2012).

2.3.2. Baseline alcohol quantity. In Year 1 participants were asked the number of drinks they would have on a typical drinking day.

2.3.3. Year 10 marijuana, tobacco, and alcohol use. Frequencies were assessed for marijuana use and tobacco cigarette smoking during the past month (0–30 days) and alcohol consumption during the past year (0–365 days).

2.3.4. General health outcomes. At both baseline and Year 10, participants rated their current health as excellent, good, fair, or poor (Wells et al., 1988). Responses were later dichotomized as excellent or not excellent (i.e., good, fair, and poor). Self-reported weight and height were used to compute body mass index (BMI) following the standard formula for adults. BMI values were then dichotomized as overweight/obese or normal/underweight, using the standard cutoff value of 25.0 (Centers for Disease Control and Prevention, 2012).