Oppose SB0708
Cannabis - Legalization and Regulation

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Maryland Senate Finance Committee and the Budget and Taxation Committee

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Thank you for the opportunity to testify today. My name is Amelia Arria and I am a Professor at the University of Maryland School of Public Health and Director of the Center on Young Adult Health and Development. I have been conducting research on substance use, including cannabis, for twenty years. I have led one of the largest federally-funded studies to date of the impact of young adult substance use.

Today I would like to focus your attention on the negative impact of cannabis use on brain function and educational achievement. Unfortunately, these issues are seldom part of the legalization conversation. The brief summary of the scientific research findings you will find in my written testimony pertains to ten of our own published studies in Maryland and many other key recent studies conducted elsewhere on this topic, 58 of which I have attached for your reference.

The sheer volume of research showing the negative impact of cannabis is clear, strong and compelling.

Young adults between the ages of 18-29 are the most likely to use cannabis. Cannabis use places young people at substantially higher risk for impaired mental health, drug dependence, and blunted academic engagement and achievement—outcomes that are at direct odds with Maryland's mission to educate and prepare our youth to thrive in a competitive work environment. The negative impacts extend across genders, racial and ethnic groups, and individuals of all socioeconomic backgrounds. Indeed, such use has the potential to adversely impact their personal and professional trajectories for years after college. Specifically, scientific studies show that cannabis use is associated with erosion of an array of cognitive skills that help us focus, plan and prioritize tasks. These deficits appear to be dose dependent and more likely to occur with earlier age at first use.

The addictive potential of cannabis is rarely discussed but is very real. Our study of more than 1,200 undergraduates found that one quarter of users met criteria for cannabis use disorder, characterized by difficulty quitting, and using despite negative consequences. It is quite likely that the negative impacts will only get worse as cannabis use and THC potency of products that are available increases.

The average concentration of THC, the psychoactive component of cannabis, has risen dramatically among available products—from 4% in 1995 to 14.5% in recent years, and is even higher in states that have legalized cannabis use. Commercialization has led to the availability of: 1) even higher potency edible THC products; 2) "dabs"—highly concentrated products usually made from butane hash oil and, 3) hash oil and waxes that can be consumed using vape pens. Use of these highly potent cannabis concentrates can lead to greater risk of dependence through eliciting a more immediate and stronger "high" they are more reinforcing to the brain. These high potency products have also raised serious concerns because of the risk of triggering adverse mental health consequences.

Research has shown that use among young adults clearly has increased following legalization initiatives. The latest national data for youth indicate an increase in frequency of use among users, especially among racial and ethnic minority youth.

Cannabis use also increases the risk of progression to other kinds of substance use. Research has shown that about 45% of cannabis users will go on to use another drug for the first time. Our most recent analysis of data from the University of Maryland indicates that cannabis users in their first year of college are at elevated risk to start using prescription drugs nonmedically, cocaine, and tobacco cigarettes. For example, 25% of cannabis users at age 18 became a new user of cocaine during the four years after starting college, vs. 2% of cannabis non-users. These differences were statistically meaningful after controlling for other variables related to the propensity to use drugs. Other research has shown that heavy drinkers are the group most likely to increase their use of cannabis following passage of legalization policies.

We have shown that cannabis use clearly undermines academic performance and can derail a student's pathway to success. In secondary school, substance use is associated with poor grades and high school dropout. Similarly, in college, drug use is associated with skipping class, spending less time studying, earning lower grades, and taking longer to graduate or not graduating at all. Negative academic effects appear to be stronger for cannabis than alcohol in studies that have compared the two substances. We call these the academic opportunity costs of substance use.

We might debate about a lot of things today, but we would all agree that all young adults in Maryland deserve a chance to fulfill their potential. No one would agree that we should make it harder for our young people to achieve academically. The scientific evidence should guide our decision-making and the science tells us that making cannabis more available can increase the risk of cognitive problems, school dropout, and academic disengagement. The subtle changes incurred by substance abuse on the developing minds of our youth do not only destroy individual potential, they can cause a ripple effect of social and economic losses across our broader society. You have a critical choice to make and I urge you to listen to the scientific evidence when you make your decisions.

Let's make Maryland a leader, not a lemming. A leader in education, a leader in workplace productivity, a leader in innovation. Let's not put up barriers that can compromise academic achievement, motivation, and personal and professional success.

Research Articles on the Adverse Impact of Cannabis on Educational Achievement and Other Outcomes

University of Maryland Publications

University of Maryland School of Public Health in collaboration with the Hazelden Betty Ford Institute for Recovery Advocacy (2019). **Marijuana is not a public health solution to the opioid crisis.** *Emerging Drug Trends Report*.

Green, K.M., **Arria, A.M.** (2019). **Will persistent patterns of youth marijuana use compromise their futures?** *Addiction*. 114(6):1049-1050.

University of Maryland School of Public Health in collaboration with the Hazelden Betty Ford Institute for Recovery Advocacy and the (2017). **Concerns rising over high-potency marijuana use**. *Emerging Drug Trends Report*.

Arria, A. M., Caldeira, K. M., Bugbee, B. A., Vincent, K. B., & O'Grady, K. E. (2016**). Marijuana use trajectories during college predict health outcomes nine years post-matriculation**. *Drug and Alcohol Dependence, 159*, 158-165.

Arria, A. M., Caldeira, K. M., Bugbee, B. A., Vincent, K. B., & O'Grady, K. E. (2015). **The academic consequences of marijuana use during college**. *Psychology of Addictive Behaviors, 29*(3), 564-575.

Arria, A. M., Garnier-Dykstra, L. M., Cook, E. T., Caldeira, K. M., Vincent, K. B., Baron, R. A., & O'Grady, K. E. (2013). **Drug use patterns in young adulthood and post-college employment**. *Drug and Alcohol Dependence, 127*(1-3), 23-30.

Arria, A. M., Caldeira, K. M., Vincent, K. B., Winick, E. R., Baron, R. A., & O'Grady, K. E. (2013). **Discontinuous enrollment during college: Associations with substance use and mental health**. *Psychiatric Services, 64*(2), 165-172.

Arria, A. M., Caldeira, K. M., Bugbee, B. A., Vincent, K. B., & O'Grady, K. E. (2013**). *The academic opportunity costs of substance use during college.*** College Park, MD: Center on Young Adult Health and Development.

Caldeira, K. M., O'Grady, K. E., Vincent, K. B., & Arria, A. M. (2012). **Marijuana use trajectories during the post-college transition: Health outcomes in young adulthood**. *Drug and Alcohol Dependence, 125*(3), 267-275.

Caldeira, K. M., Arria, A. M., O'Grady, K. E., Vincent, K. B., & Wish, E. D. (2008). **The occurrence of cannabis use disorders and other cannabis-related problems among first-year college students**. *Addictive Behaviors, 33*(3), 397-411.

Other Relevant Publications and Abstracts are included following the publications

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The Academic Consequences of Marijuana Use during College

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Abstract

Although several studies have shown that marijuana use can adversely affect academic achievement among adolescents, less research has focused on its impact on post-secondary educational outcomes. This study utilized data from a large longitudinal cohort study of college students to test the direct and indirect effects of marijuana use on college GPA and time to graduation, with skipping class as a mediator of these outcomes. A structural equation model was evaluated taking into account a variety of baseline risk and protective factors (i.e., demographics, college engagement, psychological functioning, alcohol and other drug use) thought to contribute to college academic outcomes. The results showed a significant path from baseline marijuana use frequency to skipping more classes at baseline to lower first-semester GPA to longer time to graduation. Baseline measures of other drug use and alcohol quantity exhibited similar indirect effects on GPA and graduation time. Over time, the rate of change in marijuana use was negatively associated with rate of change in GPA, but did not account for any additional variance in graduation time. Percentage of classes skipped was negatively associated with GPA at baseline and over time. Thus, even accounting for demographics and other factors, marijuana use adversely affected college academic outcomes, both directly and indirectly through poorer class attendance. Results extend prior research by showing that marijuana use during college can be a barrier to academic achievement. Prevention and early intervention might be important components of a comprehensive strategy for promoting post-secondary academic achievement.

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Drug use patterns in young adulthood and post-college employment

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Abstract

Background—The relationship between serious drug involvement and risk for unemployment is well recognized, but few studies have prospectively examined this relationship among college students. This study used longitudinal data to examine the association between drug use patterns during college and the likelihood of employment post-college, holding constant sociodemographic variables and personality characteristics. Second, we estimate the prevalence of alcohol and other drug use disorders among employed individuals.

Methods—Data were derived from the College Life Study. Participants entered college as traditional students and were assessed annually for six years, regardless of continued college attendance. Analyses were restricted to 620 individuals no longer enrolled in school by Year 6.

Results—Using multinomial regression modeling, persistent drug users [i.e., used illicit drugs (other than marijuana) and/or nonmedical prescription drugs every year they were assessed during the first four years of study] were significantly more likely than non-users to be unemployed vs. employed full-time post-college. Persistent drug users and infrequent marijuana users were also more likely than non-users to be unemployed vs. employed part-time. In Year 6, 13.2% of individuals employed full-time and 23.7% of individuals employed part-time met DSM-IV criteria for drug abuse or dependence during the past year.

Conclusions—If confirmed, the results of this study suggest that persistent drug use among academically-achieving young adults might increase risk for post-college unemployment. More research is needed to understand the processes underlying this association. Further attention should be directed at managing substance use problems among recent college graduates who have secured employment.

Keywords

College students; drug and alcohol use; employment; longitudinal study

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Discontinuous enrollment during college: Associations with substance use and mental health

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Abstract

Objective—To examine the prospective relationship of substance use and mental health problems with risk for discontinuous enrollment during college.

Methods—Participants were 1,145 college students interviewed annually at one large public university, beginning at college entry (year 1). Discontinuous enrollment was defined as a gap in enrollment of one or more semesters and operationalized as "early" (i.e., during the first two years) and "late" (i.e., during the second two years) versus "none" (i.e., continuously enrolled throughout college). Explanatory variables measured in year 1 were the Beck Depression Inventory (BDI), Beck Anxiety Inventory (BAI), childhood conduct problems, cannabis use, number of illicit drugs used, and alcohol consumption. In years 3–4, participants reported lifetime history of clinically diagnosed ADD/ADHD, depression, and/or anxiety, including age at diagnosis. Multinomial logistic regression models were developed to evaluate the association between the independent variables and discontinuous enrollment, holding constant background characteristics.

Results—Higher BDI scores predicted early discontinuity but not late discontinuity, whereas cannabis and alcohol use predicted late discontinuity but not early discontinuity. Receiving a depression diagnosis during college was associated with both early and late discontinuity. None of the self-reported pre-college diagnoses were related to discontinuous enrollment once background characteristics were taken into account.

Conclusion—Students experiencing depressive symptoms and/or seeking treatment for depression during college might be at risk for interruptions in their college enrollment. Cannabis use and heavy drinking appear to add to this risk. Students entering college with pre-existing psychiatric diagnoses are not necessarily at risk for enrollment interruptions.

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Graduate degree completion: Associations with alcohol and marijuana use before and after enrollment☆

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ABSTRACT

Research has shown that alcohol and marijuana use are associated with academic performance difficulties, but the relationship to completion of a graduate degree has not been explored. Undergraduate students (n = 1253) were assessed during their first year of college and annually thereafter until age 29. Among the subset of the original sample who enrolled in graduate school (n = 520), measures of alcohol and marijuana use were averaged separately for the time periods before and after graduate school enrollment. Logistic regression models were developed to examine the associations between these variables and graduate degree completion, adjusting for other factors. In general, a minority of the sample were excessive drinkers or frequent marijuana users. The majority of drinkers (70%) drank an average of twice a week or less each year, and 62% of marijuana users used marijuana once a month or less each year. After adjusting for demographic and program characteristics, marijuana use frequency after graduate school enrollment was negatively associated with odds of graduate degree completion. Alcohol use frequency before graduate school enrollment was positively associated with odds of graduate degree completion. Results add to the growing body of literature on marijuana use and decreased academic achievement, but results should be interpreted with caution given the small, but significant, effect sizes found. The positive association between alcohol use frequency and degree completion might be attributed to engagement in the academic environment. Future studies should examine the potential mechanisms through which alcohol and marijuana use are related to the academic achievement of graduate students.

1. Introduction

Substance use among young adults is a major public health concern and is associated with academic problems. The bulk of research in this area has focused on undergraduate students, as alcohol and marijuana use among this population are fairly common (Schulenberg et al., 2017). In addition to academic difficulties, alcohol and marijuana use are associated with other negative consequences during the college years, including risky sexual behaviors, social and interpersonal problems, injury, and impaired driving (Caldeira et al., 2009; Merrill & Carey, 2016; Pearson, Liese, Dvorak, & Marijuana Outcomes Study Team, 2017; White & Hingson, 2013).

Longitudinal research has shown that alcohol and marijuana use during college might have long-term consequences after college graduation. Heavy drinking and marijuana use during college are associated with post-college substance abuse and dependence, unemployment, less prestigious employment, and lower income (Arria, Garnier-Dykstra, et al., 2013; Jennison, 2004; Schulenberg et al., 2005; Wilhite, Ashenhurst, Marino, & Fromme, 2017). Marijuana use during college and the immediate post-college years, particularly heavy use, is associated with several negative health outcomes at ages 24 and 27, including emotional problems, injury, illness, decreased quality of life, and less service utilization for physical and mental health problems (Arria, Caldeira, Bugbee, Vincent, & O'Grady, 2016; Caldeira, O'Grady, Vincent, & Arria, 2012).

Degree non-completion as a consequence of substance use has been

Abbreviations: Y, year

☆ Note: This research was conducted as part of the doctoral dissertation of the first author.

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

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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 1,253 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.

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Marijuana use trajectories during the post-college transition: Health outcomes in young adulthood

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Abstract

Background—Despite the relatively high prevalence of marijuana use among college students, little information exists regarding health outcomes associated with different use patterns or trajectories.

Methods—Seven annual personal interviews (Years 1–7) were administered to 1,253 individuals, beginning in their first year in college. Growth mixture modeling was used to identify trajectories of marijuana, alcohol, and tobacco use frequency during Years 1–6. Logistic regression was used to evaluate the relationship between marijuana use trajectories and several Year 7 health outcomes, holding constant Year 1 health, demographics, and alcohol and tobacco use trajectories.

Results—Six marijuana use trajectories were identified: Non-Use (71.5%$_{wt}$ of students), Low-Stable (10.0%$_{wt}$), Late-Increase (4.7%$_{wt}$), Early-Decline (4.3%$_{wt}$), College-Peak (5.4%$_{wt}$), and Chronic (4.2%$_{wt}$). The six marijuana trajectory groups were not significantly different on Year 1 health-related variables, but differed on all ten Year 7 health outcomes tested, including functional impairment due to injury, illness, or emotional problems; general health rating; psychiatric symptoms; health-related quality of life; and service utilization for physical and mental health problems. Non-Users fared significantly better than most of the marijuana-using trajectory groups on every outcome tested. Chronic and Late-Increase users had the worst health outcomes.

Conclusions—Marijuana use patterns change considerably during college and the post-college period. Marijuana-using students appear to be at risk for adverse health outcomes, especially if they increase or sustain a frequent pattern of use.

Keywords

Cannabis; health outcomes; physical and mental health; health care utilization; longitudinal studies

1. Introduction

Marijuana remains the most commonly used illicit substance worldwide. In the U.S., marijuana use increased significantly among college-attending 18- to 22-year-olds from

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The Occurrence of Cannabis Use Disorders and other Cannabis-Related Problems among First-Year College Students

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Abstract

This study reports the prevalence of cannabis use disorders (CUD) and other cannabis-related problems in a large cohort (n=1253) of first-year college students, 17 to 20 years old, at one large public university in the mid-Atlantic region of the U.S. Interviewers assessed past-year cannabis use, other drug use, and cannabis-related problems (including DSM-IV criteria for CUD). The prevalence of CUD was 9.4%$_{wt}$ among all first-year students and 24.6% among past-year cannabis users (n=739). Of those endorsing any CUD criteria, 33.8% could be classified as diagnostic orphans. Among 474 "at-risk" cannabis users (≥5 times in the past year), concentration problems (40.1%), driving while high (18.6%) and missing class (13.9%) were among the most prevalent cannabis-related problems, even among those who endorsed no CUD criteria. Placing oneself at risk for physical injury was also commonly reported (24.3%). A significant proportion of cannabis-using college students meet diagnostic criteria for disorder. Even in the absence of disorder, users appear to be at risk for potentially serious cannabis-related problems. Implications for prevention, service delivery, and future research are discussed.

Keywords

Cannabis; marijuana; drug dependency; drug abuse; college students; research diagnostic criteria

1. Introduction

According to the most recent data from *Monitoring the Future*, in 2006 close to one in three (30.2%) college students had used cannabis in the past year (Johnston, O'Malley, Bachman, & Schulenberg, 2007). These prevalence estimates are similar to findings from the 2001 *Harvard College Alcohol Study* (Mohler-Kuo, Lee, & Wechsler, 2003), which reported that 30% of college students used cannabis in the past year. Moreover, as with other forms of illicit drug use, young adults consistently have a higher prevalence of cannabis use than other age groups (Substance Abuse and Mental Health Services Administration [SAMHSA], 2006), and

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ADDICTION
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COMMENTARY

Commentary on Terry-McElrath *et al.* (2019): Will persistent patterns of youth marijuana use compromise their futures?

Recent increases in the prevalence of frequent marijuana use that extend well into adulthood raise concerns about the long-term consequences for population health and for the individuals engaging in these use patterns.

With the context of marijuana use changing rapidly and marijuana use prevalence continuing to increase in the United States [1,2], the public is in great need of rigorous science on the consequences of these trends to guide policymaking. Terry-McElrath and colleagues address this need by answering important questions regarding the continuation of youth marijuana use patterns to age 30 years [3]. Using data from the Monitoring the Future Survey, a national school-based sample, they find that more recent cohorts are at the highest risk for continued frequent marijuana use. Moreover, 60% of individuals who use marijuana frequently in high school continue to use marijuana at some level when assessed at age 30, and almost a quarter continued a frequent use pattern. The authors point to decreases in perceived risk, increased tetrahydrocannabinol (THC) potency and changes in the transition to adult roles as possible reasons for these findings.

The prevalence of long-term frequent use, however, is probably much greater than this study indicates. The latent classes estimated were identified using data collected during the study participants' senior year of high school. As mentioned in the limitations [3], this school-based sample excludes those who have dropped out of high school or who do not attend regularly. This exclusion may be a result of marijuana use, as our previous research, and that of others, shows a wide range of academic performance problems associated with frequent marijuana use, including school dropout [4,5]. Moreover, the exclusion might be even greater among vulnerable groups, such as racial minorities, where school dropout is more common [6] and marijuana use is increasing [7].

The educational consequences of frequent marijuana use also seem to extend past high school [8]. Terry-McElrath *et al.* find college enrollment and completion are low among frequent adolescent marijuana users [3]. Their analyses show that just 23.8% of 12th grade frequent marijuana users graduate college, with an additional 11.3% attending college but not graduating. This compares nationally to approximately 60–70% of high school graduates enrolling in college, depending on the cohort [9].

Educational consequences are probably just the beginning of a cascade of negative effects for frequent marijuana users [4,10]. Research has shown that the effects of such use are broad, and affect domains such as social role formation, social relationships, life satisfaction and physical health symptoms, such as sleep and irritability [4,11–13]. Accumulating evidence also shows that marijuana use can precipitate or worsen existing mental health symptoms [14,15]. Interestingly, some of the purported consequences of marijuana use might be the reason for using marijuana in the first place [16]. For example, many individuals who use marijuana to sleep or relieve anxiety might unknowingly be alleviating cannabis withdrawal symptoms, which have been recently reported to occur in 12% of frequent users [17]. Similarly, although underresearched, it is possible that initiating frequent use at an early age might lead to underdevelopment of adaptive coping strategies for stress and anxiety, which could drive continued use.

The sharp increased prevalence of frequent marijuana use in recent cohorts is likely to continue and potentially worsen, considering the high prevalence of this behavioral pattern among current 12th graders, as well as use trajectories that might extend longer during the lifecourse than previously seen and evidence that relaxed marijuana legislation in the United States may impact the course of adult use [18]. Moreover, the view of marijuana as a relatively harmless substance is at odds with mounting scientific evidence and it is unfortunate that public dialogue on the negative impacts of marijuana has not been more pronounced, as these consequences can dim the bright futures of our youth. Terry-McElrath *et al.* call for greater understanding of the possible broad impacts of long-term patterns of use [3]. We propose that a crucial next step for this work is to understand how its findings, along with accumulating evidence of negative consequences from marijuana use, can guide policymaking and public health efforts, as scientists have suggested that marijuana policy has outpaced the science [19]. As more states relax their marijuana policies, persistent use and related adverse consequences are likely to continue to grow. Fast-forward to 2031, when today's high school seniors are 30 years old: how prevalent will frequent patterns of use be then; and what will be the impact of these patterns on frequent marijuana users and the rest of society?

Declaration of interests

None.

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Hazelden Betty Ford
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Emerging Drug Trends Report

April 2017 | Shedding new light, every month, on America's No. 1 public health problem

Concerns Rising Over High-Potency Marijuana Use

New research raises concerns about the ever-increasing potency of marijuana and the new ways it is being used, according to an analysis by the Hazelden Betty Ford Institute for Recovery Advocacy, in partnership with the University of Maryland School of Public Health.

The two organizations report that several recent studies point to rising potencies, a new method of consumption called "dabbing" and the use of synthetic marijuana as areas of concern.

Potency climbing

Tetrahydrocannabinol (THC) is the component of marijuana—also referred to as cannabis—that causes the "high." A recent analysis of cannabis samples confiscated by the federal Drug Enforcement Agency showed a steady increase in THC content, from 4 percent to 12 percent between 1995 and 2014 (ElSohly et al., 2016).

Traditional forms of marijuana have long been linked to cognitive problems, underachievement in school and risk for dependence, especially for youth. High-potency marijuana may pose elevated risks for negative outcomes, including emergency department visits, mental health problems, and structural brain alterations such as decreased hippocampal volume and disturbed white matter connections in the corpus callosum.

The link between cannabis use and increased risk for psychosis is fairly clear but might be even stronger for high-potency forms, according to another recent study (Murray, Quigley, Quattrone, Englund, & Di Forti, 2016). Individuals who used high-potency cannabis on a daily basis were found to be five times more likely to experience a psychotic disorder than non-users. Among people with psychosis, daily users also experienced their first episode of psychosis an average of six years earlier than non-users.

"Synthetics"

Another danger is synthetic marijuana, which has increased dramatically in popularity since the late 2000s.

Individuals who use synthetic cannabis have been found to be 30 times more likely to visit an emergency unit than those who use traditional forms of cannabis (Murray et al.,2016). And a recent study of high school students found that those who had used synthetic marijuana were at increased risk for using other drugs such as cocaine, heroin and ecstasy; getting into a physical fight; having unprotected sex; and riding with intoxicated drivers, compared with those who used marijuana only (Clayton, Lowry, Ashley, Wolkin, & Grant, 2017).

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"Dabbing"

A third reason marijuana is getting more dangerous is the new method of consumption known as "dabbing," which involves heating a strong cannabis concentrate (up to 80 percent THC), usually an oil or wax, and then inhaling the vapor. This results in a quicker and more intense "high" but can also lead to serious health consequences.

A recent study analyzed 5,000 tweets from Twitter to gain insight into the use and effects of dabbing (Cavazos-Rehg et al.,2016). Among other findings, it noted that:

- Twenty-two percent of the tweets about dabbing referenced extreme physical effects, and 15 percent mentioned using an excessive amount or engaging in several sessions back to back.
- The most common physiological symptom mentioned was passing out/losing consciousness. The second most common symptom mentioned was respiratory effects such as coughing, loss of breath and lung pain. However, only 2 percent described disliking respiratory effects. Less common symptoms included loss of body control or inability to move, nausea and vomiting, perspiration and crying/tearing up.

"Our study adds to the limited understanding of marijuana concentrates and dabbing, which are increasing in use and accessibility across the U.S. and among young people especially, who are most vulnerable to marijuana-related harms," said Patricia A. Cavazos-Rehg, PhD, co-author of the study. "Our findings signal potentially intense experiences associated with dabbing (e.g., passing out), thereby stressing the need for continued surveillance of marijuana use in this form."

Implications

Despite the consequences associated with higher potency marijuana, dabbing and synthetics, the percentage of adults and adolescents who believe regular use of marijuana poses "no risk" tripled from 5 percent in 2004 to 15.3 percent in 2014 (Substance Abuse and Mental Health Services Administration, 2004; 2014).

"Recent research highlighting the dramatic increase in marijuana potency is concerning given what is known about the possible negative effects of cannabis on cognitive functioning and mental health," said Dr. Amelia Arria, Associate Professor and Director of the Center on Young Adult Health and Development at the University of Maryland School of Public Health.

Dr. Arria noted that drug use trends in the U.S. are monitored primarily using annual household surveys and classroom-based surveys of schoolchildren, which are useful for understanding how often individuals are engaging in traditional methods of cannabis use. But they do not comprehensively measure new routes of cannabis administration or the potency of products, and she urged those large drug trend surveys to "look at patterns of high-potency cannabis and new routes of administration so we can more thoroughly understand the impact of marijuana on our society."

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Hazelden Betty Ford Foundation Perspectives

Butler Center for Research:

- Within the Hazelden Betty Ford Foundation's national system of care, more than 22 percent of patients in 2015 had a cannabis use disorder, including 36 percent of the patients at the organization's national youth treatment center in Plymouth, Minnesota.

Nick Motu, Vice President, Hazelden Betty Ford Institute for Recovery Advocacy:

- "As debates continue over legalizing and regulating marijuana, ever-expanding access and demand may be leading to stronger marijuana, with greater potential for negative health consequences."
- "While the perceived risks of marijuana use are decreasing, some health concerns are actually on the rise."

Dr. Joseph Lee, Medical Director, Hazelden Betty Ford Foundation Youth Continuum:

- "It's economics. No matter what the consumable substance is, there will always be a demand for bigger, better, faster and more. This is true for caffeinated beverages and alcohol. It's also true for marijuana. Potency is one differentiator in a capitalistic marketplace."
- "The issue of higher potency cannabis, even five or six years ago, got a lot of laughter from those who joked that 'this isn't your parents' marijuana.' Today, though, there's no question that higher-grade marijuana is here, and some young people are actively seeking it out."
- "We are seeing more signs of psychosis among our young patients who use concentrates. Some kids even swear off dabs and concentrates because of the paranoia and anxiety they experience."
- "We know the earlier a young person starts to use any mood- and mind-altering substance, the greater the possibility of developing addiction. There are two important variables here. One is the impact of the substance on a developing person. The other is that early adopters of substance use are readily identifying themselves as high risk for future substance-related problems, in much the same way that people who frequent fast food restaurants are identifying as being at risk for metabolic syndrome."
- "Some people start dabbing because they have developed a tolerance for regular cannabis, and dabbing is the next step up. Some young people who smoke, however, are wary of dabbing and its psychoactive effects, so you'll find a diversity of opinion from using youth."
- "There are very specific kinds of psychotic symptoms that marijuana and concentrates can cause. They usually aren't hallucinations and are better classified as 'ideas of reference,' where they feel certain things in their environment are connected and that they have the unique perspective to tease out these hidden meanings. Kids joke about illuminati, aliens and conspiracy theories but also comment on people they know who smoke and become truly delusional about such concepts."

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- "I actually think some kids who smoke daily and use concentrates are more in tune with the pitfalls of compulsive use than adults. The youth we see talk quite honestly about whether they feel their use is compulsive or whether their use has had negative impacts on their lives. Some report being concerned by fellow smoking friends for getting 'carried away' or addicted. For the ones who do develop problems with marijuana, they actually fear backlash from others that their addiction won't be taken seriously and don't feel safe or supported in a social dialogue that invalidates their struggles."
- "Marijuana legalization efforts alter black market economics but are not effective in stopping black market sales. Perhaps due to poor regulation or supply chain issues, many young people I see from across the country talk about getting their 'high quality' marijuana and concentrates from 'legitimate' growers who liquidate their surplus at a heavily discounted price."

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Emerging Drug Trends Report | Hazelden Betty Ford Institute for Recovery Advocacy

Shedding new light, every month, on America's No. 1 public health problem

This report was produced in collaboration with the University of Maryland School of Public Health, with support from the Hazelden Betty Ford Foundation's Butler Center for Research.

Contact: Jeremiah Gardner, JJGardner@HazeldenBettyFord.org, 651-213-4132

Our mission is to provide a trusted national voice on all issues related to addiction prevention, treatment and recovery and to facilitate conversation among those in recovery, those still suffering and society at large. We are committed to smashing stigma, shaping public policy and educating people everywhere about the problems of addiction and the promise of recovery.

Hazelden Betty Ford Foundation

Emerging Drug Trends Report

July 2019 | Shedding new light on America's No. 1 public health problem

Clearing Away the Confusion: Marijuana is not a Public Health Solution to the Addiction Crisis

Overview

With more than 70,200 deaths occurring in 2017, the public health crisis of fatal drug overdoses is headline news and shows no signs of abating (National Institute on Drug Abuse, 2019). Beneath this alarming statistic are also tens of millions of individuals and their loved ones who *live* every day with addiction. Expanding access to naloxone to help prevent opioid overdose deaths in the short term is critical, but we cannot let short-term solutions overshadow or replace the need to provide high-quality treatment services to individuals with all forms of addiction to stem the tide of future overdose cases. Individuals with opioid use disorder usually use other substances: cocaine and benzodiazepines figure prominently in overdose deaths, for example. Another fast-growing concern is methamphetamine use. Of course, alcohol remains ever-present as well and is part of the picture for the vast majority of people who suffer from addiction. As previously discussed in the *Emerging Drug Trends Report* "Widening the Lens on the Opioid Crisis," a continuum of approaches to identify high-risk individuals and intervene appropriately is needed to make progress.

Recently, some advocates have claimed that marijuana might be part of the solution to the opioid crisis. Within the past year, states such as New York and Illinois have passed legislation making medical marijuana more accessible to individuals with opioid prescriptions (Illinois General Assembly, 2018; New York State Department of Health, 2018). However, clinical evidence produced from rigorous research methodology that marijuana is an effective treatment for pain or opioid use disorder does not exist; therefore, marijuana should not be promoted as a safe alternative (Humphreys & Saitz, 2019). The notion that increased access to marijuana will help the country shed its current addiction crisis does not have scientific merit, and distracts from planning and implementing a longer-term and broader set of evidence-based strategies. A recent study by Chen et al. (2019) reaffirmed the urgency of implementing a multifaceted approach involving prevention, treatment and harm reduction to address the opioid overdose crisis. The annual number of overdose deaths is expected to increase by nearly 150% between 2015 and 2025.

This report clarifies the current state of scientific understanding on the relationship between marijuana and opioid use. While more research is needed to fully comprehend the complex issues discussed, and to develop new interventions and treatments for addiction, decades of existing research findings should serve as the foundation of policy decisions.

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State-level correlations between marijuana policies and opioid medication prescribing

A recent study examined data for Medicare Part D recipients living in all 50 states. The authors investigated whether prescribing patterns for opioids were different based on the state's marijuana policies. Bradford and colleagues (2018) specifically measured the total number of daily doses for any opioid medication prescribed to a person from 2010 through 2015. States with any type of medical marijuana law had an estimated 2.1 million fewer daily doses of opioid prescriptions per year than states without a medical marijuana law (the average among all states was 23.1 million daily doses). States with medical marijuana dispensaries and those that allow home cultivation were estimated to have 14.4% and 6.9% fewer, respectively, daily doses of opioids prescribed. Although it is tempting to speculate that the lower prescribing was due to marijuana policies, the study results cannot conclude that differences in marijuana policies were the reason for the different opioid prescribing rates. There could have been several other reasons for the state-level differences in opioid prescribing rates besides the marijuana laws that were in place at the time the data were examined.

Medicare Part D is an optional prescription drug benefit plan available to Medicare recipients in the U.S. More than 70% of Medicare recipients are enrolled in Medicare Part D.

Wen and Hockenberry (2018) examined opioid prescribing patterns among Medicaid recipients living in the eight states that implemented medical marijuana laws between 2011 and 2016. In four of the eight states, statistically significant reductions in opioid prescribing rates were found during this period. Of the four states that implemented recreational marijuana laws, three also experienced significant reductions in opioid prescribing rates. Just as in the study described above, however, this study cannot determine that the decrease in opioid prescribing was due to differences in the marijuana laws. It must also be noted that the results from these studies (Bradford et al., 2018; Wen & Hockenberry, 2018) were observed among specific groups of individuals: Medicare and Medicaid recipients. The researchers cannot say if state-level reductions in opioid prescribing have been or will be observed among the general public in states with marijuana laws. Caution is warranted when considering whether to use these findings when making policy decisions about access to marijuana that will affect the general public.

State-level correlations between marijuana policies and opioid overdoses

Bachhuber and colleagues (2014) compared opioid overdose death rates, rather than prescribing patterns, in states with and without marijuana legalization. Between 1999 and 2010, the opioid-related death rate rose in all states, but states with a medical marijuana law had higher rates of opioid-related mortality than states without such a law. However, when the influence of medical marijuana policies was isolated from the influence of the state and year in which the data were collected, the researchers found that states with a medical marijuana law had an estimated 24.8% fewer opioid overdoses per year on average compared with states that had no medical marijuana law. A more recent study (Shover, Davis, Gordon, & Humphreys, in press) refutes the findings of Bachhuber (2014). Using essentially the same approach but extending the time of analysis through 2017, the newer study found that the direction of the association reversed—states enacting a medical marijuana law experienced a 22.7% increase in opioid overdoses. When Shover and colleagues (in press) applied additional statistical controls that were not part of the earlier study, they found no association between the two variables. This more recent study seriously calls into question the claim that medical marijuana laws have any beneficial impact on opioid overdose death rates and suggests instead that such laws could potentially have a negative impact.

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Beware of the "ecological fallacy"

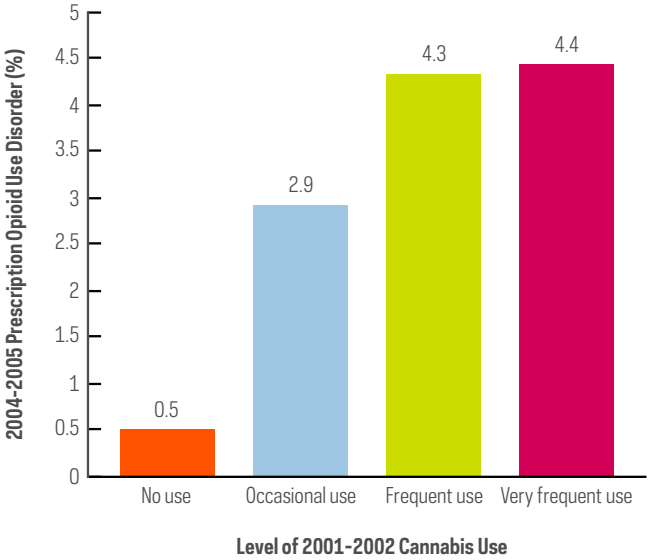
The most important consideration when evaluating the studies cited earlier is that they were all conducted at the state level. Ecological studies like these, which utilize measurements of health that have been averaged across a population, are often valuable first steps in identifying a possible relationship between an exposure and some outcome—in this case, marijuana policies and opioid prescribing rates or overdose deaths. However, studies conducted at the state level cannot and should not be used to draw conclusions about individual behaviors; such conclusions are known in public health science as "ecological fallacies."

For example, if you compared volunteering across multiple schools, you would discover that some schools have a higher proportion than others of students who volunteer in their community. Yet the reason for volunteering might not have anything to do with school policies or school environments. Rather, the choice to volunteer might stem from many other influences, such as home life, work schedules or personal interests. Similarly, it would be an ecological fallacy to assume that because opioid prescribing or overdose deaths decreased among states with legal marijuana policies, individuals in those states reduced their opioid use because of increased availability of marijuana.

Studies at the individual level: Marijuana use increases risk for subsequent opioid use and dependence

The other side to the story regarding marijuana and opioids is how the two substances are related to each other at the individual level. The vast majority of individuals who misuse prescription pain medication and/or heroin initiated their drug use early in their teens, usually beginning with alcohol and marijuana. Biologically, early initiation of drug use primes the brain for enhanced responses to other drugs later in life. Most recently, Caputi and Humphreys (2018) show the heightened risk of prescription opioid misuse among medical marijuana users. Using nationally representative data, they found that medical marijuana users have twice the risk for prescription opioid misuse compared with non-users of medical marijuana. Although this study used data collected at one point in time, the findings raise doubts that medical marijuana can be protective against the development of opioid use disorder.

Figure 1. Level of 2001-2002 Cannabis Use and Incident 2004-2005 Prescription Opioid Use Disorder in the National Epidemiological Survey on Alcohol and Related Conditions (NESARC); (Olfson, Wall, Liu, & Blanco, 2018)



Similarly, Olfson and colleagues (2018) analyzed a different nationally representative dataset from two time periods—2001 to 2002 and 2004 to 2005. Individuals who used marijuana from 2001 to 2002 had nearly three times the odds of starting to use opioids nonmedically three years later compared with their counterparts who did not use marijuana (after adjusting for demographic factors and other substance use history). Increased risk for beginning to use opioids nonmedically was observed among a subset of adults with moderate to severe pain as well.

Opioid use disorder is the clinical diagnosis used to identify whether or not use of pain relief medication or heroin causes an individual significant impairment, including health problems, physical withdrawal, persistent or increasing use, and failure to satisfy

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responsibilities at work, school or home (Substance Abuse and Mental Health Services Administration, 2017). In Olfson et al. (2018), marijuana use was associated with two times the odds of developing opioid use disorder within three years, compared with those who did not use marijuana. Figure 1 shows that the proportion of individuals who developed opioid use disorder by 2004 to 2005 increased as 2001 to 2002 frequency of marijuana use increased.

Another study utilizing several years of data also observed that marijuana use increases risk for subsequent nonmedical use of opioids. Fiellin et al. (2013) examined the association between marijuana use and subsequent misuse of prescription opioids among young adults 18 to 25 years old using nationally representative data from 2006 to 2008. More than one-third of young adults who misused opioids had already initiated marijuana use in their lifetime prior to prescription opioid misuse. Young adults who had previously used marijuana had 2.5 times the odds of starting to misuse prescription opioids compared with those who had not used marijuana. The risk posed by previous marijuana use was about twice the risk from using other common substances, such as alcohol and cigarettes (1.2 and 1.3 times the odds, respectively). A recent study by Butelman et al. (2018) underscored young adulthood as a critical developmental period for intervention as individuals with opioid dependence started their heaviest use of marijuana at 19 years old on average.

Substituting one drug for another has implications

Some authors of ecological studies examining the relationship between marijuana use and opioid prescribing rates have argued that more liberalized marijuana laws might help combat the current opioid epidemic by allowing individuals to manage their pain with marijuana rather than prescription opioids. However, these studies do not determine if successful pain treatment replacement is actually occurring. To our knowledge, the majority of studies of this nature conducted so far have utilized online questionnaires at one time point to ask individuals who already used marijuana—medically and nonmedically—about their opioid use and substitution practice (Boehnke, Litinas, & Clauw, 2016; Corroon, Mischley, & Sexton, 2017; Reiman, Welty, & Solomon, 2017; Sexton et al. 2016). These studies have shown that marijuana is being used to manage pain regardless of legalization laws; unfortunately, weak methodology prevents more substantive conclusions about the efficacy of replacing prescription opioid use with marijuana use. Longitudinal studies with longer-term data collection that could provide a clearer picture of the benefits and harms of pain management substitution have not yet been conducted.

Perhaps the methodologically strongest study that attempts to determine whether or not marijuana use for pain treatment improves patient outcomes is "The Pain and Opioids in Treatment" study (Campbell et al., 2018). Campbell et al. recruited 1,514 participants from pharmacies across Australia with non-cancer pain who were prescribed opioids between 2012 and 2014, and then followed up with them four years later. By the end of the study, 24% of the participants had also used marijuana for pain management and 60% had interest in using marijuana for pain (compared with 33% who had interest at the beginning of the study). Participants who used marijuana for pain had greater pain severity, reported that pain interfered with life more and had greater generalized anxiety disorder compared with their peers who did not use marijuana. Importantly, the research team did not find any relationship between marijuana use for pain and actual pain severity as time progressed. The study concluded that marijuana use did not reduce an individual's prescriptions for opioids or increase opioid discontinuation. While this study was conducted in Australia, and therefore cannot be directly generalized to the United States due to differences in marijuana use policies, this study offers the strongest evidence to date that at the individual level, marijuana use for pain does not decrease opioid use or improve pain outcomes.

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As described earlier, several studies assessing risk for opioid use conducted at the individual level have found that those who use marijuana are more likely to start misusing prescription opioids and developing opioid use disorder compared with those who do not use marijuana (Fiellin et al., 2013; Olfson et al., 2018). Individuals with chronic pain who use marijuana are also not immune from the increased risk for starting to misuse prescription opioids, a finding that further calls into question the claim that increased medical marijuana use would reduce opioid misuse and overdose (Olfson et al., 2018).

Conclusions

- The claim that increased access to marijuana through legalization policies could help combat the opioid crisis must be viewed with skepticism. These ideas were never directly tested but were derived from ecological studies comparing prescribing rates and overdose rates at a state level. From ecological studies, there is no way to attribute prescribing patterns and overdoses to the laws and not to other factors. The most recent replication of these earlier ecological studies utilizing data that extended through 2017 did not find any evidence that medical marijuana laws were associated with a decrease in opioid overdose mortality. Some analyses from the replication study actually suggested that comprehensive medical marijuana laws were associated with increases in overdose deaths.
- Studies using strong scientific methods show that marijuana use increases the risk for starting to misuse prescription opioids, rather than lowering the risk. Moreover, individuals with addiction to prescription opioids often have a history of using other drugs, including marijuana, and therefore need comprehensive addiction intervention and treatment.
- Marijuana use to manage pain does not appear to be related to decreases in pain, and evidence that marijuana is an effective treatment for opioid use disorder is even weaker (Humphreys & Saitz, 2019).
- Experts predict that the opioid overdose crisis will worsen in the coming decade. As a result, there is a need for novel, multipronged interventions in order to change the epidemic's trajectory.
- When dealing with the addiction and overdose crisis facing the U.S., policymakers should make decisions that have a strong scientific justification.

Making marijuana more available might appear to be a solution to the current drug crisis in our nation. However, a more critical look at the research evidence suggests just the opposite. Decades of research findings have shown that marijuana use puts an individual at heightened risk for misuse of prescription opioids, heroin and other drugs.

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Insights and Perspectives

Marvin D. Seppala, MD, Chief Medical Officer, Hazelden Betty Ford Foundation

- "We need to study cannabis and its derivatives (i.e., CBD) to determine which health conditions could benefit and how such products would work. As important, we need to determine the limitations—what cannabis and its derivatives do not affect or help. We've jumped the gun and allowed relatively indiscriminate use by a large portion of the population without adequate scientific study."

George Dawson, MD, Psychiatrist, Hazelden Betty Ford Foundation

- "The commercially driven political aspects of medical cannabis are undeniable. The legalization of cannabis for recreational purposes had no traction with American politicians or voters until it was promoted as a miracle drug. Due to that widespread promotion, medical cannabis is now legal in 33 states, and recreational cannabis is legal in 10. The legalization arguments have also suggested that the U.S. was behind other countries of the world despite the fact only two countries—Canada and Uruguay—have completely legalized cannabis for medical and recreational sale and purchase. In fact, only 22 of 195 countries have legalized medical cannabis, with widely varying restrictions on its use. The Netherlands is often cited as an example of recreational cannabis legalization, but most Americans don't realize that cannabis is illegal for recreational use in most places there, with use and sale allowed only in specially licensed coffee shops. The promotion of cannabis as a solution to the opioid overuse and chronic pain problems can be seen as an extension of the commercially driven political arguments for legalization that outpace any science to back them up.

  "At the scientific level, areas of research in the epigenetics of cannabis smoke and how that may predispose people to substance use problems has been left out of the debate. The neurobiological mechanisms of how cannabis can modify the underlying brain substrate at various developmental stages is currently an area of active research. Many such studies focus on the issue of whether cannabis-induced epigenetic changes predispose to the development of opioid use disorders."

Kate Gliske, PhD, Research Scientist, Butler Center for Research, Hazelden Betty Ford Foundation

- "These studies, and others like them, highlight an increasing trend across the U.S. and worldwide to minimize the harm associated with marijuana use. This is particularly problematic given the substantial evidence of marijuana's harmful effects on mental health disorders, pregnancy outcomes and brain functioning (see Memedovich et al., 2018 for review) among a significant minority of the population. Very little research currently exists about the relationship between marijuana legalization and its effects on the opioid crisis, and what is available presents a conflicted picture of its effectiveness. We are still years away from understanding the full effect of current marijuana legalization policies on opioid use, and it would be rash to base further policy decisions on so little data."

Stephen Delisi, MD, Medical Director, Professional Education Solutions, Hazelden Betty Ford Foundation

- "All aspects of the debate around medical cannabis for chronic pain and opioid use disorder point to the dire need for a deliberate, thoughtful and science-driven approach. Medical providers, payers, patients, governmental agencies and the general public should demand that science and research guide decision-making and policies around this issue."

Nick Motu, Vice President and Chief External Affairs Officer, Hazelden Betty Ford Foundation

- "The dialogue around cannabis legalization has been muddied by the federal government's neglect of this issue and the desperate desire for solutions to the nation's opioid crisis. It is time for Congress and the Administration to course-correct in a responsible, necessary and politically viable way—by having the science drive the policy to protect the health and well-being of Americans."

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The Academic Opportunity Costs of Substance Use During College

A Brief Report from the
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About the Center on Young Adult Health and Development

The Center on Young Adult Health and Development (CYAHD) was established at the University of Maryland School of Public Health in 2009. This research center is one of the first such centers in the United States specifically dedicated to understanding the health and development of young adults. More information about CYAHD can be found at www.cyahd.umd.edu.

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Introduction

Most people recognize the devastating toll alcohol poisonings and drug-related violence exact on college campuses. The more subtle academic costs of college drinking and drug use might be less noticeable—but can have long-term impacts on student success. National statistics paint a troubling picture of our nation's college graduation rates, with 56% of male and 61% of female first-time, full-time students who sought a bachelor's degree at a four-year college in fall 2004 completing their degree at that college within six years.[1]

To remain globally competitive in today's knowledge-based economy, colleges are placing a high priority on improving their graduation rates. While many factors are in play, this report sharpens the focus on how substance use and mental health problems might contribute to what we call a "cascade of academic problems", starting with missing class, through failing grades, to dropping out.

Another related issue is that even among college students who graduate, finding a job after college is not always easy. Many graduates report getting jobs after college that don't require a college degree,[2] *and they are beginning to wonder whether the time and money they spent on college was even worth it. Colleges and parents should promote the message that excessive drinking and substance use can interfere with acquisition of skills and experiences needed to be competitive in today's job market.*

Substance use has an insidious way of interfering with a student's ability to take advantage of all that college has to offer. Interventions to reduce rates of substance use should be part of any college's plan to improve student retention.

College can and should be one of the most rewarding and memorable periods in the lives of those who are fortunate enough to have the chance to experience it. But substance use has an insidious way of interfering with a student's ability to take advantage of all that college has to offer. The time has come to shift our thinking away from the normalcy of partying during college toward finding solutions to reduce rates of substance use to promote students' long-term success and well-being.

This report sheds light on the research linking excessive alcohol and drug use during college to academic performance. By interfering with the achievement of educational goals, substance use can be viewed as having "academic opportunity costs", which ultimately can undermine a student's ability to fulfill his/her individual potential. In sum, although partying might be emblematic of college life, it comes with a price.

op·por·tu·ni·ty cost:
what a person sacrifices when they choose one option over another

Key Research Findings

- ***Alcohol and drug use are prevalent among college students.*** On average, 40% of college students drink alcohol excessively, with little change in trends during the last decade,[3] 16% meet criteria for an alcohol use disorder, and 22% used a drug during the past month, with marijuana being the most common.[4] Nonmedical use of prescription medications can also be a serious problem, but this use varies significantly across colleges.[5,6] Moreover, excessive drinking and drug use often overlap.[7]

- ***Excessive drinking and drug use are both associated with short-term academic problems.*** Students who use substances during college spend less time studying and skip more classes,[8-11] thereby reducing their exposure to the classroom learning environment and the beneficial experience of interacting with faculty and other students.

- ***Excessive drinking and drug use can interfere with college degree completion.*** Longitudinal research has found that students who use alcohol and drugs are more likely to have disruptions in their enrollment in college and also fail to graduate.[12,13] Associated mental health problems can exacerbate the adverse academic consequences of excessive drinking and drug use.[14]

- ***Neurobiological research has identified mechanisms by which excessive drinking and drug use might interfere with academic performance.*** New neurobiological research shows that substance use "hijacks" reward pathways in the brain.[15,16] Over time, the rewards of academic achievement can be replaced with the temporary rewards of intoxication and getting high. The end result is decreased motivation to pursue academic goals and disengagement from college.

Reducing the rates of excessive drinking and drug use among college students could have profound impacts on student retention and could positively impact their long-term success and employability.

- ***Reducing excessive drinking and drug use is a viable strategy for improving academic performance and retention.*** The relationship between excessive drinking, drug use, and academic performance and retention in college is rarely acknowledged in educational circles. Interventions to reduce the rates of excessive drinking and drug use among America's college students could have profound impacts on college retention and could positively impact the long-term success and employability of college graduates.

Just how much are we investing in college students?

In 2010, there were roughly 21 million college students in the United States,[1] and the average annual cost of attending college was $21,889.[17] Most of this cost was paid by families (26% by students, 37% by parents), but 33% was provided by scholarships, grants, and other forms of financial aid.[17]

The 2013 budget for the Department of Education includes $165 billion for federal grants, loans, and work study, an increase of 69% from the 2008 budget.[18] In 2013, the American Opportunity Tax Credit will provide approximately $19.1 billion in tax breaks for students and their families.[18] The Department of Veterans Affairs spent an additional $11 billion on educational benefits to Veterans, reservists, and active duty personnel in 2012 through the GI Bill and other programs.[19]

Promoting College Student Success: What is at Stake?

The personal investments made by students and families leading up to college matriculation are enormous. Moreover, there is no question that financial investments in higher education are significant for taxpayers. For the individual student, a college degree translates to greater opportunities and earning potential over their lifetime.[20] For society, a well-educated workforce enhances the growth and stability of the entire economy, with attendant benefits in terms of global competitiveness and general welfare.

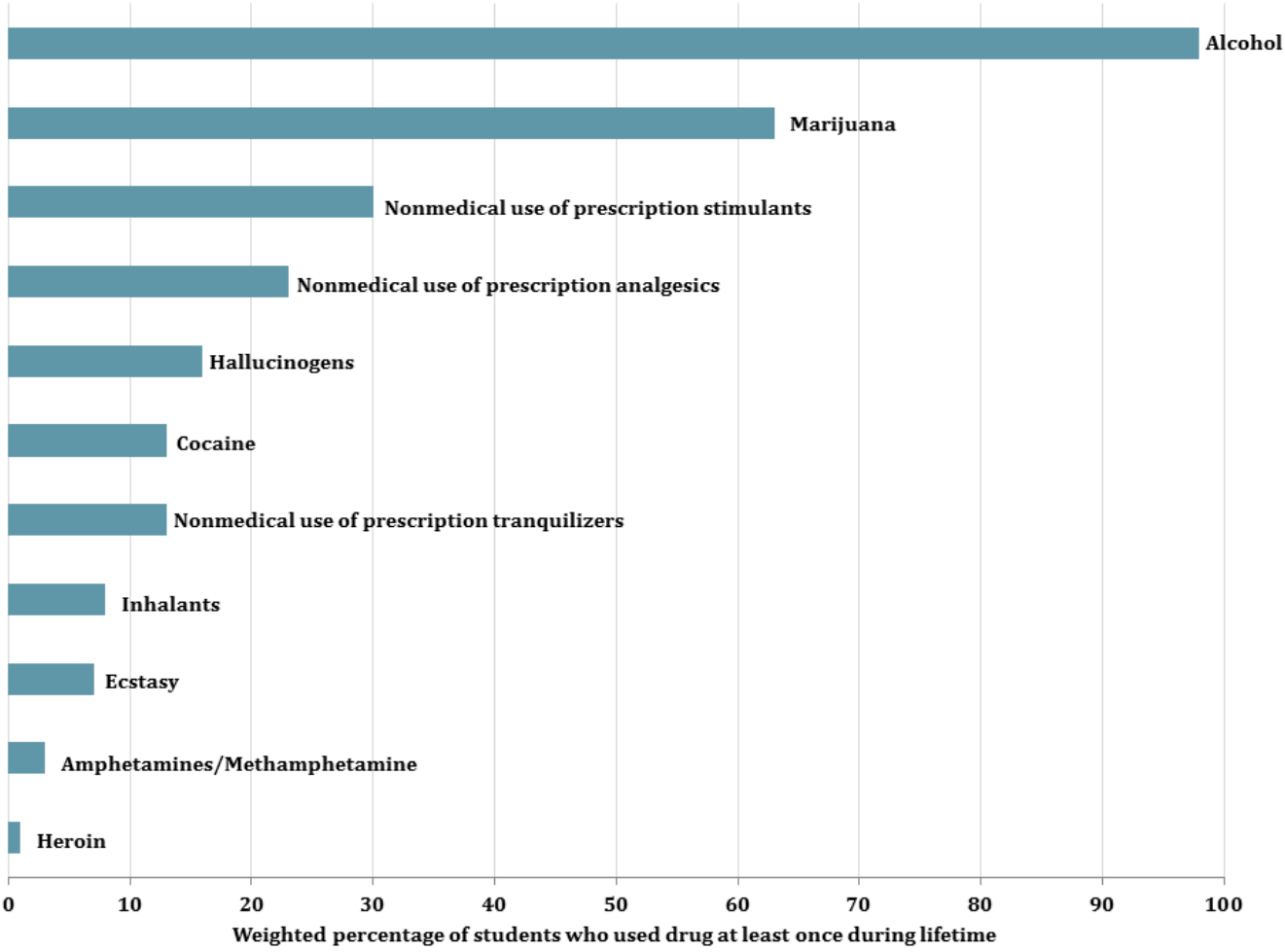
Unfortunately, too many college students in the U.S. are underperforming or failing to graduate. About half of students enrolled in a four-year college graduate within six years of entry to that college, and trends have not changed substantially during the last two decades.[1,21] Those who do graduate often do so without having mastered the skills employers demand.[22]

Prevalence of Alcohol and Drug Use During College

Alcohol and drug use are highly prevalent among college students. Forty percent of U.S. college students have had five or more drinks in a row during the past two weeks, with little change in trends during the last decade,[3] and 16% meet criteria for an alcohol use disorder.[4] Nationally, 22% are current drug users, with marijuana being the most common drug used.[4] For some students, use is far from being isolated occasions of "experimentation", with many developing alcohol and drug use patterns that are severe enough to be clinically significant. In one large study, one in four marijuana-using students met criteria for dependence.[23] Students who use drugs—either illicit drugs or prescription drugs used nonmedically—are often the same students who drink heavily. In fact, drug use typically signifies a higher level of alcohol involvement, and on average, the heavier the alcohol use, the heavier the drug use.[7,24]

Nationally, 58% of students who attend a four-year college complete a degree there within six years. Trends indicate little sign of improvement.[1,21] Moreover, many college graduates have not mastered the skills employers demand.[22]

Figure 1. Prevalence of alcohol and drug use by the fourth year of college



Source: College Life Study, unpublished data. See the following papers for more information:
Arria AM, Caldeira KM, O'Grady KE, Vincent KB, Fitzelle DB, Johnson EP, Wish ED. Drug exposure opportunities and use patterns among college students: Results of a longitudinal prospective cohort study. *Subst Abus. 2008;29(4):19-38.*
Vincent KB, Kasperski SJ, Caldeira KM, Garnier-Dykstra LM, Pinchevsky GM, O'Grady KE, Arria AM. Maintaining superior follow-up rates in a longitudinal study: Experiences from the College Life Study. *Int J Mult Res Approach. 2012;6(1):56-72.*

Problems Often Begin During High School

Alcohol use among college students typically begins long before college entry. Students who drink alcohol during high school are likely to continue their drinking patterns when they enter college,[25] and research shows that their frequency of excessive drinking sometimes escalates.[26] High school seniors with plans to go to college are less likely to have used marijuana than students with no college plans (35% vs. 42%),[27] but after starting college, opportunities to use drugs are common. One study found that while 38% of college students had tried marijuana before coming to college, an additional 25% began using marijuana for the first time after starting college.[28]

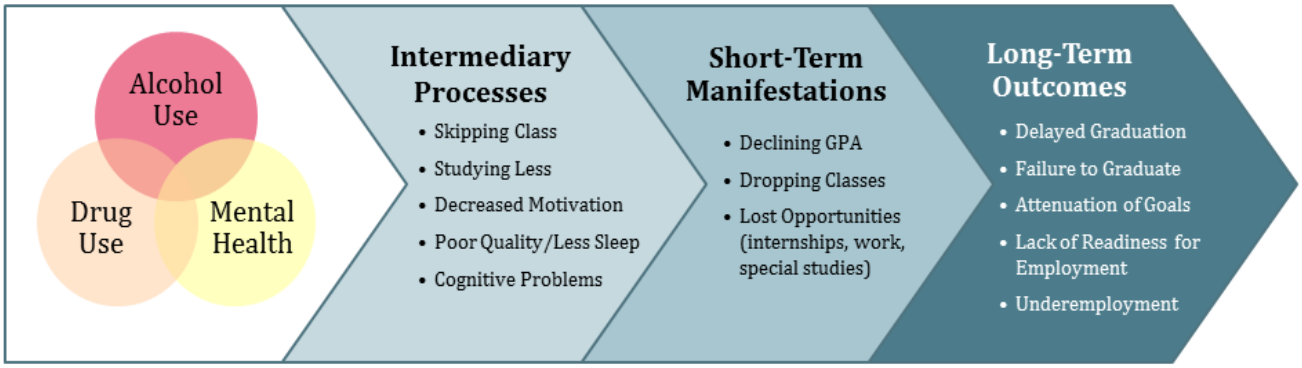
During adolescence, excessive drinking and drug use can affect academic performance in at least two major ways.[16] First, the use of alcohol and drugs during early adolescence adversely affects brain

development (see below, *Neurobiological Consequences of Substance Use*), potentially interfering with a student's motivation and ability to learn. Second, high school students who use alcohol or drugs often affiliate with peers who tend to reject conventional norms—such as a respect for authority and a belief in the value of academic pursuits. Although it is common for early conduct problems to be present even before alcohol or drug use begins, substance use can perpetuate the student's involvement in a variety of problem behaviors and can further their alienation from both school and their parents.

Excessive Alcohol Use and/or Drug Use During College Contributes to a Cascade of Adverse Consequences

Several research studies have shed light on the relationship between substance use during college and academic performance and retention. The effects of excessive drinking and/or drug use during college can be understood as a "cascade" of interrelated problems that accumulate over time (see Figure 2). Students who drink excessively tend to spend less time studying[8,10] and skip more of their classes.[11] As with excessive drinking, drug use—especially marijuana use—appears to contribute to college students skipping more classes, spending less time studying, earning lower grades, dropping out of college, and being unemployed after college.[8,9,11,12,29-33] In fact, the cascade of consequences is similar regardless of whether students are drinking excessively, using drugs, or nonmedically using prescription drugs. For example, one study showed that college students who nonmedically used prescription stimulants and analgesics skipped 21% of their classes, whereas non-users skipped only 9% of their classes.[9] Another study found that the more drinks a student consumed per drinking occasion, the less time they spent studying, which led to predictable negative effects on their GPA.[10] Accordingly, drug use and excessive drinking also set the stage for disruptions in college enrollment, or "stopping out" from college[12,32] (see Box 1). Ultimately, this trajectory can lead to a greater likelihood of delayed graduation or a failure to graduate.[34] The cascade of consequences even extends beyond college graduation in the form of poorer employment outcomes and lower lifetime earnings.[8,20,31,35]

Figure 2. Alcohol use, drug use, and mental health outcomes have a cascade of effects on college students' academic outcomes



Box 1. Drug Users Have Increased Risk for Discontinuous Enrollment

Students (*N*=1,133) at one large university were categorized into groups according to their longitudinal patterns of drug use during four years of college. Two sets of trajectory groups were created: 1) based on how often they used marijuana each year, and 2) based on how many drugs other than marijuana that they used each year.

Both marijuana (Figure 3) and drug use other than marijuana (Figure 4) were significantly related to higher chances of discontinuous enrollment (i.e., not being enrolled for one or more semesters) or "stop-out", sometime during the first four years of college, even after controlling for the effects of demographics, high school GPA, and personality variables. For example, students who used marijuana very frequently all four years (i.e., "Chronic/Heavy" users) were twice as likely as "Minimal" users to experience discontinuous enrollment. Even "Infrequent" marijuana users were 66% more likely than Minimal users to be discontinuously enrolled.

Figure 3. Risk for discontinuous enrollment or "stop-out" by pattern of past-month marijuana use

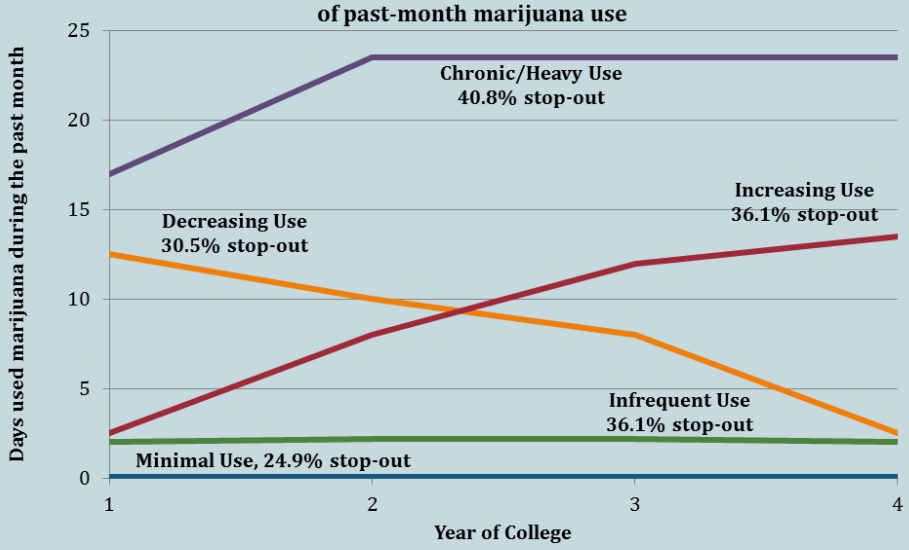
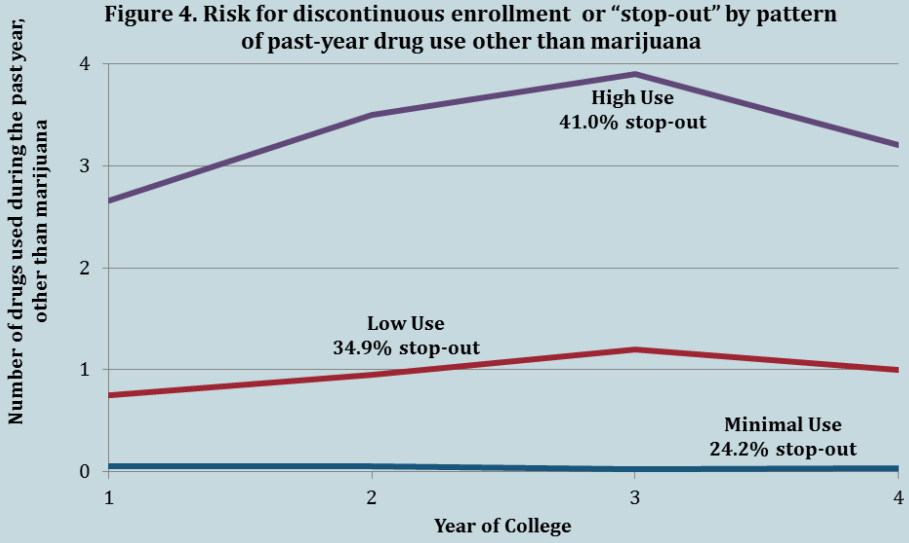


Figure 4. Risk for discontinuous enrollment or "stop-out" by pattern of past-year drug use other than marijuana



Source: Arria AM, Garnier-Dykstra LM, Caldeira KM, Vincent KB, Winick ER, O'Grady KE. Drug use patterns and continuous enrollment in college: Results from a longitudinal study. *J Stud Alcohol Drugs.* 2013;74(1):71-83.

Some of the other intermediary processes influencing academic outcomes supported by empirical research are alcohol-related changes in cognitive functioning and sleep problems. Specifically, excessive drinking is known to cause problems with short-term memory and other brain functions,[36] which in turn can undermine the efficiency and effectiveness of study time. It has also been observed that alcohol-related differences in sleep patterns contribute to greater daytime sleepiness and, consequently, lower grades.[37] Finally, although it is hard to account for differences in the difficulty of certain majors, there is some evidence that heavy drinkers gravitate toward less demanding majors.[8,38] For example, in one study heavy drinkers were more likely than their counterparts to choose a social science or business major and less likely to choose education, engineering, or the natural sciences.[8]

It is important to acknowledge that there are numerous challenges to overcome in this line of research, and findings have sometimes been mixed. Researchers have measured alcohol involvement in many different ways, and whereas students with greater severity of alcohol problems are more likely to have poorer academic outcomes, more moderate measures of alcohol use are not correlated as strongly with academic problems. There are many confounding factors that are related to both academic performance and heavy drinking, such as having an extraverted personality and being more engaged with campus life.[13,39-41] Once these factors are taken into account, the association between heavy drinking and attrition from college becomes more readily apparent.[13] For example, it might seem paradoxical that students who are highly engaged in campus life—meaning they attend more parties, concerts, and sporting events—are both more likely to stay enrolled in college and tend to get drunk more often, as compared to their less "engaged" counterparts. Because of this paradox, heavy drinking might appear to have no bearing on a student's likelihood of staying enrolled, but by using statistical methods that take into account the relationship between heavy drinking and event attendance, we can see that heavy drinking in fact strongly predicts a lower likelihood of re-enrolling the following semester.[13]

Neurobiological Consequences of Substance Use

Exposure to alcohol and drugs, especially during the vulnerable period of adolescent development as mentioned earlier, can lead to acute cognitive problems such as difficulty concentrating and sleep disturbances.[36,37,42-44] These cognitive problems no doubt make it more difficult to function academically. Recent research has identified areas of the brain involved in learning and memory that are adversely affected by alcohol consumption.[45] Heavy alcohol consumption during adolescence has been shown to be associated with structural and functional changes during brain development that can manifest as poor planning, impaired executive functioning, and spatial and attention deficits.[46]

Extensive research has documented the cognitive effects of marijuana use.[42,47-50] Deficits are more likely when use is initiated earlier in life and when use is more frequent.[51-53] While acute effects of marijuana intoxication are well recognized and include numerous attention and concentration difficulties, as well as decreased working memory, decision response speed, and information processing,[54,55] longer-term problems have been demonstrated as well.[56,57] Neuropsychological deficits

include impaired planning, organizing, and problem solving. Research studies have also shown longer-term residual deficits related to the allocation of attentional resources, filtering out irrelevant material, and retrieval and immediate verbal memory deficits related to substance use,[58,59] all of which are necessary for performing well inside and outside of the classroom. Importantly, these problems have been observed even after statistically adjusting for baseline intellectual ability.[58] Early chronic marijuana use has been linked to declines in IQ of up to 8 points,[60] which for a person with an average IQ corresponds to a drop from the 50th percentile to the 30th percentile.[61]

Mental Health is also an Important Part of the Picture

A more complete understanding of the relationship between substance use and academic outcomes must also take into account mental health problems, which often co-exist with substance use[62,63]—and can have similar adverse impacts on academic performance. Research shows a strong association between early and chronic marijuana use and mental health problems such as depression, anxiety, and early onset and worsening symptoms of psychosis.[64-69]

Many students meet criteria for psychiatric disorders—such as depression, bipolar, or anxiety disorders[70]—and nearly half say that their mental health affected their academic performance during the past month.[71] In general, the presence of a psychiatric disorder makes a student significantly less likely to complete college, especially when those disorders are diagnosed during college.[29,30,32,72] For first-year students in particular, the ability to persist into the second year of college is a critically important milestone—one that becomes more unlikely when they experience more depression, anxiety, and stress.[32,73] Even when students are able to persist in college, their grades are likely to suffer in proportion to their mental health symptoms.[74]

For first-year students in particular, the ability to persist into the second year of college is a critically important milestone—one that becomes less likely when they experience more depression, anxiety, and stress.

Because of the way that excessive drinking, drug use, and mental health problems tend to cluster together among the same students, it is important to recognize that their effects on academic outcomes do not overlap completely. In fact, all three problems appear to have separate, additive effects on some outcomes (e.g., discontinuous enrollment[32]). It is also not surprising that they interact in complex ways to influence academic performance. For example, the academic consequences of drinking—such as falling behind on work and missing class—can be more pronounced when the drinker also has mental health problems.[14]

Improved Academic Outcomes are Likely to Result from Effective Substance Use and Mental Health Interventions

A full discussion of the interventions available to address these issues is beyond the scope of this report. However, campus leaders who are ready to confront these issues do have a range of effective options at their disposal.[75-78] Research has shown that, for high school students, interventions that succeed in curbing drinking are likely to lead to improved class attendance in the short run.[79] College students are likely to experience similar benefits, thereby improving their grades and graduation rates in the long run. Motivational interviewing, during which feedback on alcohol consumption is provided by a counselor in a non-confrontational manner, has been shown to be effective at reducing alcohol use among college students.[80-82] This type of intervention can assist the student in identifying discrepancies between values or goals, such as academic success, and his/her drinking behavior,[83] and could be done in a variety of settings on campus, including health centers, counseling centers, or academic assistance centers. Computer-delivered interventions can also be used to assess alcohol consumption and provide personalized feedback to students.[84] In response to academic failure, rather than simply requiring students to stay out of school for a semester, administrators can engage students in personalized interventions to help students address any underlying problems with substance use, mental health, or other personal issues. This type of approach shows promise for improving their chances of persisting and eventually completing college.[85]

Interventions in the larger environment on- and off-campus can also help to curb excessive alcohol use among college students. Evidence-based strategies include campus-community partnerships, publicizing and enforcing underage-drinking laws and zero tolerance laws for drivers under 21, reducing youth access to alcohol, decreasing the density of alcohol outlets near the campus, and increasing the price of alcohol around college campuses.[86-90] An environment that is less supportive of excessive drinking and more

> ***"In addition to reducing other adverse outcomes associated with drinking…policies to reduce college students' drinking can be expected to improve the quality of human capital they accumulate. The immediate benefits of this include reducing the likelihood of students dropping out of college because of poor grades and improving the likelihood of entrance into graduate programs (which is based largely on college GPA). The long-term consequences of improved academic performance include greater labor market participation and higher earnings."[10]***

conducive to student success can be established by combining strong leadership from college administrators and an involved and informed community to implement a comprehensive program of evidence-based strategies.[87]

Summary

Excessive drinking and drug use remain significant problems on many college campuses. Contrary to the popular perception that substance use is a "normal" rite of passage endemic to the college experience, the more likely scenario—according to research evidence—is that it undermines students' ability to succeed academically. Given the new research evidence, it behooves college leaders to recognize the connection between alcohol and drug use and academic retention, readiness and motivation to succeed, and view substance use prevention and intervention as a viable strategy to promote student success. More attention should be focused on identifying existing successful intervention models and designing innovative comprehensive approaches to promote student success.

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