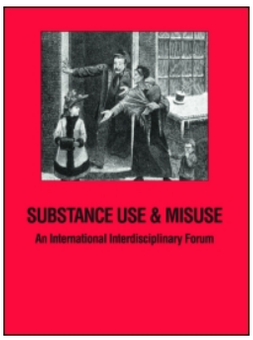

Substance Use & Misuse

ISSN: 1082-6084 (Print) 1532-2491 (Online) Journal homepage: http://www.tandfonline.com/loi/isum20

Marijuana Use and Driving Under the Influence among Young Adults: A Socioecological Perspective on Risk Factors

Carla J. Berg, Carmen N. Daniel, Milkie Vu, Jingjing Li, Kathleen Martin & Lana Le

To cite this article: Carla J. Berg, Carmen N. Daniel, Milkie Vu, Jingjing Li, Kathleen Martin & Lana Le (2017): Marijuana Use and Driving Under the Influence among Young Adults: A Socioecological Perspective on Risk Factors, Substance Use & Misuse, DOI: 10.1080/10826084.2017.1327979

To link to this article: http://dx.doi.org/10.1080/10826084.2017.1327979

Published online: 04 Aug 2017.

SUBSTANCE USE & MISUSE
2017, VOL. 0, NO. 0, 1–11
https://doi.org/10.1080/10826084.2017.1327979

Taylor & Francis
Taylor & Francis Group

ORIGINAL ARTICLE

Marijuana Use and Driving Under the Influence among Young Adults: A Socioecological Perspective on Risk Factors

Carla J. Berg, Carmen N. Daniel, Milkie Vu, Jingjing Li, Kathleen Martin, and Lana Le

Department of Behavioral Sciences and Health Education, Emory University School of Public Health, Atlanta, Georgia, USA

ABSTRACT

Background: Given increases in marijuana use and driving under the influence (DUI), it is critical to identify those at risk in order to inform intervention efforts. *Objectives*: We used a socioecological framework to examine correlates of level of marijuana use and DUI in the past month among young adult marijuana users. *Methods*: We recruited 1567 participants aged 18–34 years via Facebook ads targeting tobacco and marijuana users in August 2014 to complete an online survey assessing marijuana use and DUI, as well as related multilevel factors. Analyses focused on 649 participants reporting past 30-day marijuana use. *Results*: The sample was an average age of 24.48 (SD = 5.10), 43.9% female, and 76.4% White and used marijuana an average of 17.86 (SD = 11.29) days in the past month. Notably, 48.4% reported driving after marijuana use at least once in the past month, and 74.0% were passengers. Multivariable regression indicated that greater use was associated with: being older; being male; greater symptoms of dependence; residing in a state with recreational marijuana legalized; having a medical marijuana card; having parents and more friends who use; higher coping motives; lower perceived harm to health; and less concern about driving after marijuana use (adjusted *R*-squared = 0.294). Correlates of driving after using marijuana in the past month included: being younger; more frequent use; having more friends who use; higher enhancement motives; and less concern about driving after using (Nagelkerke *R*-squared = 0.442). *Conclusions/Importance*: Interventions and campaigns should address social norms and risk perceptions regarding marijuana use, particularly as it relates to DUI.

KEYWORDS

Marijuana use; driving under the influence; risk factors; risk perceptions; young adults

Introduction

Marijuana is the most commonly used federally illicit drug in the US (Substance Abuse and Mental Health Services Administration [SAMSHA], 2014), and recent national survey data has shown an increasing prevalence of marijuana use (SAMSHA, 2013, 2014). For example, according to the 2014 National Survey on Drug Use and Health (SAMSHA, 2015), 8.4% of those aged 12 or older were current (past 30-day) users of marijuana, demonstrating an increase in use prevalence compared to the period of 2002 to 2013. A particularly high-risk group for marijuana use is young adults (aged 18 to 24), with an estimated 19.6% of this age group reporting current marijuana use (SAMSHA, 2015).

The effects of marijuana use on individuals and public health are still being widely debated. Marijuana may be helpful in managing a wide range of medical conditions and complications (e.g., AIDS wasting, spasticity from multiple sclerosis, depression, post-traumatic stress disorder, anxiety, chronic pain, nausea associated with chemotherapy) (Institute of Medicine, 1999; Campbell et al., 2001; Narang et al., 2008). However, marijuana use has also been linked to a number of adverse health problems, such as cardiovascular effects (Sidney, 2002), respiratory/pulmonary complications, impaired immune function, risk of head, neck, and/or lung cancer (Zhang et al., 1999), and poor psychosocial outcomes, such as psychiatric conditions, interpersonal violence, and poorer school and work performance (Khalsa, Genser, Francis, & Martin, 2002; Gruber, Pope, Hudson, & Yurgelun-Todd, 2003; Stinson, Ruan, Pickering, & Grant, 2006; D'Souza, 2007; Brook, Stimmel, Zhang, & Brook, 2008; Volkow, Baler, Compton, & Weiss, 2014).

In particular, marijuana use is associated with increased risk for traffic accidents and fatal collisions (Asbridge, Hayden, & Cartwright, 2012; Volkow et al., 2014). Data from the Fatality Analysis Reporting System in six US states indicates that the prevalence of drivers testing positive for marijuana has increased by almost three times over the past decade (Brady & Li, 2014). Although the legalization of marijuana does raise concerns about increased driving fatalities, the literature is not conclusive regarding whether legalization increases this risk (Santaella-Tenorio et al., 2017). However,

CONTACT Carla J. Berg cjberg@emory.edu Department of Behavioral Sciences and Health Education, Emory University School of Public Health, 1518 Clifton Road, NE, Room 524, Atlanta, GA 30322, USA.

this concern still remains and warrants continued investigation. The risk for impaired driving under the influence (DUI) of marijuana may be particularly concerning among young adults, as they represent the largest segment of marijuana users (SAMSHA, 2015). This concern is further compounded by the fact that young adults are significantly overrepresented among those killed or seriously injured in motor vehicle crashes (National Highway Traffic Safety Administration, 2016).

Drawing from the Socioecological Model (McLeroy, Bibeau, Steckler, & Glanz, 1988) and Social Cognitive Theory (Bandura, 1977; Bandura, 2004), we posit that several factors might influence level of marijuana use as well as DUI of marijuana. These include policy-level factors such as statewide regulation of marijuana; community-level factors such as living environment and ways of accessing marijuana; interpersonal influences (e.g., use of marijuana by parents or friends); and individual factors related to marijuana use including outcome expectancies (e.g., motives for use, risk perceptions), preferred modes of use, and co-use with other substances. Identifying such factors may inform future conceptual models and interventions regarding risk for greater marijuana use and for DUI.

At the policy level, the increase in marijuana use has coincided with increased state-level decriminalization and legalization of marijuana. Since 2012, eight states (Colorado, Washington, Oregon, Alaska, California, Nevada, Maine, and Massachusetts) and the District of Columbia have legalized recreational marijuana use for adults (≥21 years old). These states also permit the manufacturing and sale of marijuana and related paraphernalia. In addition to recreational marijuana legalization, 25 states have medical marijuana use and/or decriminalization laws (National Conference of State Legislatures, 2016, May 23). Just recently, in 2016, California, Maine, Massachusetts, and Nevada voted to legalize recreational marijuana, and Arkansas, Florida, Montana, and North Dakota voted to legalize medical marijuana. Moreover, a majority of US adults now favor legalization of marijuana (Pew Research Center, 2013), suggesting that marijuana deregulation will increase in the near future. Unfortunately, recent studies have found that state-level marijuana legalization is associated with an elevation in prevalence of marijuana use in impaired driving cases as well as an increase in the number of vehicle crashes (Li et al., 2012; Anderson, Hansen, & Rees, 2013; Couper & Peterson, 2014; Salomonsen-Sautel, Min, Sakai, Thurstone, & Hopfer, 2014).

Alongside these policy changes, community-level factors such as the ways of accessing marijuana have changed. The marijuana industry has become one of the fastest growing industries in the US, with the legal marijuana market projected to be over $7 billion in 2016 and $22 billion by 2020 (Sola, 2016). These estimates demonstrate astonishingly high growth rates for any industry, and they only account for the sale of marijuana occurring in regulated states. Individuals in states with medical or recreational marijuana legalization may now access marijuana through dispensaries or retailers, rather than just the black market available to those in states with no legalized marijuana.

As the policy and retail environment has changed, so have interpersonal influences and individual perceptions regarding marijuana use and its effects. In terms of interpersonal influences, marijuana was perceived to be more socially acceptable than the range of tobacco products (e.g., cigarettes, little cigars and cigarillos, e-cigarettes, hookah, smokeless tobacco) (Berg et al., 2015). Having parental figures and friends who use marijuana is correlated with increased odds of using marijuana (Berg et al., 2015). Interpersonal influences can also be seen in a range of reasons underlying marijuana use, such as to conform, among others (Simons, Correia, & Carey, 2000).

Regarding intrapersonal factors, young adults have been reported to perceive marijuana as being among the most socially acceptable and as having among the lowest risks in relation to harm to health and addictiveness, compared to a range of traditional and emerging tobacco products (Berg et al., 2015). However, limited research has documented the extent to which marijuana users believe that use impairs their ability to drive and how this relates to use levels or actual high-risk driving behavior.

Within the new marijuana retail environment, there has also been a diversification of marijuana products and rapid changes in the modes of use. Marijuana can be consumed in multiple ways, including smoking or inhaling it in joints, bowls or pipes, bongs, water pipes, hookahs, and blunts (cigars filled with marijuana); eating or drinking it in food products and beverages/concentrates; or vaporizing it, among other modes (Volkow et al., 2014). These modes are used to consume different marijuana products, including cannabis herb, resin, oil, and others (Loflin & Earleywine, 2014). Moreover, growing proportion of marijuana sales in legalized states are from newer marijuana products, such as edibles, concentrates, and topicals (e.g., lotions, lip balms) (Comnes, 2016; Marijuana Business Daily, 2016, June).

In terms of use patterns, data show that co-use of marijuana with alcohol and tobacco in young adults is of great concern. Those in young adulthood have some of the highest rates of substance use relative to any other age group (Dawson, Grant, Stinson, & Chou, 2004; Grant, Hasin, Chou, Stinson, & Dawson, 2004; Grant et al., 2006; Rath, Villanti, Abrams, & Vallone, 2012), as well as high

rates of polysubstance use (Cohn et al., 2015; Holmes, Popova, & Ling, 2016). Co-use of marijuana and alcohol may increase the risks associated with DUI of either alone or of both together.

The rapidly evolving political and community context surrounding marijuana and the resulting shifts in social norms and individual beliefs about marijuana use and its effects point to a need to examine multilevel factors associated with increased use and DUI of marijuana. However, limited research has examined multilevel factors across the socioecological continuum—from policy context to individual level. Thus, the current study aimed to address this important gap in the literature and specifically examines state-level marijuana-related policy; community-level factors of access to marijuana and types/modes of marijuana product available/used; interpersonal-level factors, specifically social influences (i.e., parent/friend use); and intrapersonal-level factors, particularly outcome expectancies (i.e., motives for use, risk perceptions), and other substance use (i.e., tobacco, alcohol) in relation to number of days of marijuana use and DUI of marijuana in the past 30 days among current young adult marijuana users recruited via social media.

Methods

Procedures

The [omitted for blind review] Institutional Review Board approved this study, IRB# 00073636. We recruited participants who met our eligibility criteria of (1) residing in the US; and (2) being aged 18–34 years, using the definition of "young adult" used by the US Census Bureau (United States Census Bureau, 2016) in order to obtain a broad range of young adult use patterns. Recruitment was done via advertisements targeting tobacco and marijuana users and nonusers on Facebook, a social networking website. Recruitment occurred over a 3 week period in August 2014. We advertised to Facebook users who "liked" certain tobacco- or marijuana-related pages (e.g., major cigarette brands, links to e-cigarette ads or companies) or had identified related interests (e.g., "legalize marijuana"). Advertisements included images of tobacco products, marijuana-related images, and other benign images (e.g., books, fruits/vegetables) intended to recruit nonusers. Our recruitment was modeled after other published research methods (Ramo & Prochaska, 2012) and was intended to obtain samples of tobacco users, marijuana users, and nonusers, respectively, in order to conduct other analyses requiring comparisons among these groups (Berg, 2016).

Individuals who clicked on the advertisement were directed to a page describing the survey study and the consent statement. Consenting individuals were screened for eligibility (i.e., age); those eligible were forwarded to the online survey, administered via www.surveygizmo.com. To limit duplicate responses, one response per IP address was permitted. The survey took approximately 30 minutes to complete. Participants were compensated $5.

Participants

Of the 4510 individuals who started the survey, 2251 did not complete the entire survey (52.6% of whom did not move past the information and consent); 699 were disqualified, including 482 who were outside the age range, 77 who declined consent, and 140 who provided invalid responses (e.g., gave an age that did not correspond to the birth year provided). Thus, 1567 had complete and valid responses. The overall sample of 1567 was an average of 25.17 (SD = 5.09) years old, 49.6% male, and 87.0% White. Our overall sample of 1567 respondents included 1249 who reported using marijuana in their lifetime and 649 who reported using marijuana in the past 30 days.

Our analyses focused on the 649 past 30-day marijuana users. This subsample was an average age of 24.48 (SD = 5.10) years old; 56.1% male, 76.4% White, 14.4% Hispanic, and 63.0% with greater than a high school education (Table 1). (Note that this subset of marijuana users versus the entire parent study sample was slightly younger [vs. 25.17 (SD = 5.09)] and was comprised of more males [vs. 49.6%] and fewer Whites [vs. 87.0% Whites overall].)

Measures

The survey assessed the outcomes of marijuana use level (and other characteristics regarding patterns of use) and DUI, as well as a range of factors across the Socioecological Model from policy to the intrapersonal level (McLeroy et al., 1988).

Marijuana use. Participants were asked if they had used marijuana in their lifetime and, if so, the number of days they used in the past 30 days (SAMSHA, 2013). Those using in the past 30 days were considered current users to determine our sample (SAMSHA, 2013). While we operationalized our outcome of *level of use* as number of days of use in the past 30 days, we also asked current users to report the number of times they used marijuana on the days that they used it. To assess *symptoms of addiction*, we developed items from the DSM-IV regarding substance dependence (American Psychological Association, 1994) and asked participants the extent to which each of the following statements was true for them, ranging from 1 ("not at all true for me") to 5 ("absolutely true for me"): "I need more marijuana now than I did previously in order

Table 1. Participant sociodemographic characteristics in relation to number of days of use and driving under the influence (DUI) of marijuana in the past 30 days among young adult current marijuana users, $N = 649$.

	Total sample N (%) or M (SD)	Number of days used in past 30		DUI		
		M (SD) or r	*p*	No $N = 335$ (51.6%) M (SD) or N (%)	Yes $N = 314$ (48.4%) M (SD) or N (%)	*p*
Sociodemographics						
Age (SD)	24.48 (5.10)	− 0.02	0.61	24.88 (5.28)	24.05 (4.86)	0.04
Sex (%)			0.05			0.13
Male	354 (54.5)	18.72 (11.18)		159 (47.5)	126 (40.1)	
Female	285 (43.9)	16.68 (11.39)		170 (50.7)	184 (58.6)	
Other	10 (1.5)	20.80 (9.62)		6 (1.8)	4 (1.3)	
Race/Ethnicity (%)			0.25			0.20
White	496 (76.4)	17.57 (11.32)		251 (74.9)	245 (78.0)	
Other	153 (23.6)	18.78 (11.15)		84 (25.1)	69 (22.0)	
Hispanic/Latino (%)			0.40			0.40
Yes	92 (14.4)	16.88 (11.25)		46 (13.9)	46 (14.9)	
No	549 (85.6)	17.94 (11.38)		286 (86.1)	263 (85.1)	
Education (%)			0.005			0.78
≤High school	240 (37.0)	19.39 (11.08)		128 (38.2)	112 (35.7)	
Some college	328 (50.5)	17.47 (11.30)		165 (49.3)	163 (51.9)	
≥Bachelor's degree	81 (12.5)	14.89 (11.26)		42 (12.5)	39 (12.4)	
Employment/education (%)			0.64			0.10
Employed part- or full-time	310 (47.8)	18.07 (11.49)		154 (46.0)	156 (49.7)	
College student part-/full-time	144 (22.2)	17.08 (10.94)		68 (20.3)	76 (24.2)	
Unemployed or other	195 (30.0)	18.10 (11.25)		113 (33.7)	82 (26.1)	

to get the same effect; I experience withdrawal symptoms when I do not use marijuana; I have experienced physical or psychological harm from marijuana use; I sometimes use marijuana in larger amounts or for longer than I planned to; I have tried to cut down on my marijuana use but have been unsuccessful; I spend significant time obtaining or thinking about marijuana or recovering from its effects; and I sometimes find myself avoiding situations or activities because I want to be able to use marijuana." The scale had a range of 7 to 35 and a Cronbach's alpha of 0.82. Because this was a newly created scale, we also examined the scale's validity by conducting correlations with other indicators of addiction. Scores were correlated with number of days of use of marijuana ($r = 0.20$, $p < 0.001$) and number of times used per day on days used ($r = 0.16$, $p < 0.001$). Participants also were asked if they believed they were addicted, and the scale scores correlated with perceptions of being addicted ($r = 0.40$, $p < 0.001$). These correlations indicate convergent validity.

To assess *modes of use* (which is highly driven by the policy and community retail context), we asked, "Which of the following ways have you used marijuana?" with the following response options (check all that apply): "Smoked in a joint; Smoked in a bowl; Digested with or without food; Drank it; Smoked in a water pipe or bong without tobacco; Smoked in a water pipe with tobacco; Vaporized it with a vaporizer without tobacco; Vaporized with tobacco mixed with it; Rolled in cigar papers without tobacco; Rolled in cigar papers with tobacco; Other." We also asked, "How do you use marijuana most of the time?," using the same response options.

Driving under the influence (DUI). To assess *DUI of marijuana*, we asked, "During the past 30 days, how many times did you drive a car or other vehicle when you had been using marijuana?" with response options of "0 times; 1 time; 2 or 3 times; 4 or 5 times; or 6 or more times." We dichotomized this variable as reporting any DUI in the past 30 days versus none. In order to further characterize our sample, we also assessed other high-risk behaviors related to driving by asking, "During the past 30 days, how many times did you drive a car or other vehicle when you had been using both alcohol and marijuana?; During the past 30 days, how many times did you ride in a car or other vehicle driven by someone who had been using marijuana?; and During the past 30 days, how many times did you ride in a car or other vehicle driven by someone who had been using both alcohol and marijuana?" with the same response options.

Policy-level factor. To account for *state-level marijuana policy*, we asked participants to report which state they lived in. We coded the states as: (1) neither active medical or recreationally legal environment (i.e., no open dispensaries as of August 2014); (2) active medically legal environment (i.e., only medical dispensaries actively open at that time); and (3) active medically and recreationally legal state (i.e., either actively open).

Community-level factors. Assuming type of community might impact the influence of marijuana retail environment, we also assessed *type of community* (i.e., rural, urban, suburban). To assess *ways of accessing marijuana*, we asked, "Where do you usually buy your marijuana? I don't buy it; I get it from friends; I purchase

it from someone in my community, neighborhood, or social group; I purchase it from someone that I contact exclusively to buy marijuana; From a medical marijuana dispensary; Other (please specify)." We also asked, "Do you currently have a medical marijuana card?"

Interpersonal-level factors. To assess social influences, we asked participants to report their relationship status and whether they have children. We also asked, "Does any one of your parental figures use marijuana?" and "Out of your 5 closest friends, how many of them use marijuana?" (Berg et al., 2015).

Intrapersonal-level factors. We assessed *motives for use* via the Drinking Motives Scale, which was previously adapted to marijuana use (Simons et al., 2000). This is a 25-item questionnaire assessing five motives for use including: social (e.g., "to be sociable"), enhancement (e.g., "to get high"), coping (e.g., "to forget my worries"), conformity (e.g., "so that others won't kid me about not"), and expansion (e.g., "to be more open to experiences"). Participants are instructed to indicate how often they have used marijuana for each reason on a 5-point Likert scale with 1 being "almost never/never" and 5 being "almost always/always." In the current study, Cronbach's alphas for marijuana use subscale scores, respectively, were 0.90, 0.90, 0.91, 0.90, and 0.93. To assess *risk perceptions*, participants were asked, "How addictive do you think marijuana is?" and "How harmful to your health do you think the use of marijuana is?" and are provided with a 7-point Likert scale with response options ranging from 1 ("not at all") to 7 ("extremely") (Berg et al., 2015). We also asked participants to indicate their agreement on a 5-point Likert scale of 1 ("disagree completely") to 5 ("agree completely") to the following statements: "I do not worry about getting a DUI when driving when I have been using marijuana" and "I feel completely in control of my driving when I use marijuana." To assess o*ther substance use*, participants were asked if they had used the various tobacco products (i.e., cigarettes, little cigars or cigarillos, smokeless tobacco, e-cigarettes, hookah) or alcohol in the past 30 days. Those using in the past 30 days were considered current users (SAMSHA, 2013).

Sociodemographics assessed included age, sex, race (with an option to select all that apply), ethnicity, education level, and employment status.

Data analysis

Participant characteristics were summarized using descriptive statistics. Bivariate analyses were conducted to examine sociodemographics and the aforementioned marijuana and other substance use characteristics in relation to (1) number of days of marijuana use in the past 30 days; and (2) DUI of marijuana in the past 30 days. Specifically, for the outcome of number of days of use, ANOVAs and *t*-tests were used to examine associations between categorical variables and level of use, and correlations were used to examine continuous variables in relation to use level. For the outcome of DUI in the past 30 days, Chi-squareds were used to examine associations between categorical variables and DUI, and ANOVAs and *t*-tests were used to examine continuous variables in relation to DUI. Multivariable regression (linear and binary logistic, respectively) was used to identify correlates of each outcome. In the multivariable regression, we forced select sociodemographics (i.e., age, sex, race/ethnicity, education) into each equation. Factors significantly correlated with each outcome at the $p < 0.05$ level in bivariate analyses were included in the regression. We did not include modes of use in the multivariate models, as our bivariate analyses showed that modes of use were highly correlated with level of use. We examined other instances of collinearity among variables; while there were some associations, none exceeded a correlation of 0.50. SPSS 23.0 was used for all data analyses. Statistical significance was set at $\alpha = 0.05$ for all tests.

Results

Descriptive statistics

Tables 1 and 2 provide data regarding participant characteristics and bivariate analyses. Regarding policy environment, nearly two-thirds (65.3%) lived in a state without any medical or recreational policies, 27.9% lived in states with medical marijuana legalized, and 6.8% lived in states with medical and recreational marijuana legalized (Table 2). In terms of community-level influences, 31.7% lived in urban communities, 40.8% in suburban, and 27.4% in rural. The most common way of accessing marijuana was from friends (29.8%), followed by buying it from someone in their communities (27.6%) or from a dealer (25.8%), and 11.6% had a medicinal marijuana card and reported obtaining marijuana from a dispensary.

In terms of interpersonal factors, 37.6% were married or living with a partner, 29.9% had a parent who used marijuana, and this sample had on average 3.85 (SD = 1.36) of their 5 closest friends using marijuana. Regarding intrapersonal factors, the highest rated motives for use were for enhancement and expansion. Of particular note, 44.5% of participants reported not being concerned about getting a DUI as a result of driving after marijuana use, and 62.3% reported feeling in control of their driving after using marijuana (rated 5 [agree completely] or 4 [agree somewhat]; not shown in tables).

Table 2. Level of marijuana use and driving under the influence (DUI) of marijuana in the past 30 days in relation to policy, community, interpersonal, and intrapersonal factors among young adult current marijuana users, $N = 649$.

		Number of days used in past 30		DUI		
	Total sample N (%) or M (SD)	M (SD) or r	*p*	No $N = 335$ (51.6%) M (SD) or N (%)	Yes $N = 314$ (48.4%) M (SD) or N (%)	*p*
Use level						
Days of marijuana use, past 30 days (SD)	17.86 (11.29)	—	—	14.62 (11.72)	21.32 (9.69)	<0.001
Number of times used per day (SD)	6.07 (14.86)	0.22	<0.001	5.78 (15.60)	6.37 (14.04)	0.62
Symptoms of dependence (SD) [a]	13.38 (5.99)	0.20	<0.001	27.49 (6.06)	29.70 (5.73)	<0.001
State marijuana policy (%)			0.20			0.06
Illegal	424 (65.3)	17.31 (11.33)		205 (61.2)	219 (69.7)	
Medical only legal	181 (27.9)	18.67 (11.26)		103 (30.7)	78 (24.8)	
Medical and recreational legal	44 (6.8)	19.80 (10.78)		27 (8.1)	17 (2.6)	
Community factors						
Community type (%)			0.03			0.39
Urban	206 (31.7)	19.56 (10.89)		104 (31.0)	102 (32.5)	
Suburban	265 (40.8)	17.24 (11.33)		145 (43.3)	120 (38.2)	
Rural	178 (27.4)	16.81 (11.51)		86 (25.7)	92 (29.3)	
Channels of access (%)			<0.001			<0.001
Don't buy; get it from a friend	193 (29.8)	11.27 (10.57)		136 (40.6)	57 (18.2)	
Buy from someone in my community	179 (27.6)	19.82 (9.88)		62 (18.5)	117 (37.4)	
Buy from a dealer	167 (25.8)	21.04 (10.40)		67 (20.0)	100 (31.9)	
Dispensary	75 (11.6)	22.47 (10.66)		44 (13.1)	31 (9.9)	
Other	34 (5.2)	18.82 (12.09)		26 (7.8)	8 (2.6)	
Possesses medicinal marijuana card (%)	70 (10.8)	24.34 (8.64)	<0.001	38 (11.3)	32 (10.2)	0.37
vs. no	579 (89.2)	17.07 (11.32)		297 (88.7)	181 (89.8)	
Interpersonal factors						
Relationship status (%)			0.42			0.11
Married or living with partner	244 (37.6)	18.32 (11.57)		134 (40.0)	110 (35.0)	
Other	405 (62.4)	17.58 (11.11)		201 (60.0)	204 (65.0)	
Have children (%)			0.83			0.46
No	494 (76.1)	17.91 (11.33)		254 (75.8)	240 (76.4)	
Yes	155 (23.9)	17.68 (11.16)		81 (24.2)	74 (23.6)	
Parental use (%)	194 (29.9)	20.65 (10.67)	<0.001	99 (29.6)	95 (30.3)	0.46
vs. no	455 (70.1)	16.67 (11.34)		236 (70.4)	219 (69.7)	
Friend use (SD)	3.85 (1.36)	0.33	<0.001	3.65 (1.44)	4.05 (1.24)	<0.001
Intrapersonal factors						
Use motives (SD) [b]						
Social	8.32 (5.86)	0.20	<0.001	7.31 (5.88)	9.38 (5.65)	<0.001
Enhancement	12.89 (5.37)	0.22	<0.001	11.70 (5.76)	14.13 (4.61)	<0.001
Conformity	1.25 (3.19)	− 0.02	0.62	0.95 (2.43)	1.57 (3.81)	0.02
Coping	8.62 (5.97)	0.28	<0.001	7.98 (6.06)	9.28 (5.82)	0.006
Expansion	10.26 (6.97)	0.21	<0.001	9.19 (7.05)	11.37 (6.72	<0.001
Risk perceptions (SD)						
Addictiveness [c]	2.54 (1.79)	0.04	0.27	2.51 (1.83)	2.57 (1.74)	0.66
Harm to health [c]	2.18 (1.49)	− 0.18	<0.001	2.23 (1.50)	2.13 (1.48)	0.41
I do not worry about getting a DUI after marijuana use [d]	3.03 (1.59)	0.28	<0.001	2.33 (1.43)	3.58 (1.49)	<0.001
I feel completely in control of my driving when I use [d]	3.72 (1.48)	0.36	<0.001	1.51 (0.93)	3.01) 1.54)	<0.001
Other substance use, past 30 days (%)						
Alcohol use	501 (77.3)	17.53 (11.23)	0.17	253 (75.5)	249 (79.3)	0.15
vs. no	148 (22.7)	18.98 (11.45)		82 (24.5)	65 (20.7)	
Tobacco use	577 (88.9)	17.98 (11.37)	0.43	301 (89.9)	276 (48.4)	0.25
vs. no	72 (11.1)	16.86 (10.63)		34 (10.1)	38 (12.1)	

[a] Symptoms of dependence: On a scale of 7 to 35, with higher scores indicating greater symptoms of dependence.
[b] Use motives: On a scale of 5 to 25, with higher scores indicating greater endorsement of that motive.
[c] On a scale of 1 = not at all to 7 = extremely.
[d] On a scale of 1 to 5.

Level of marijuana use

Average number of days of marijuana use in the past 30 days among users was 17.86 (SD = 11.29; median = 20.00; interquartile range [IQR] 5, 30), with average use per day on days used being 6.07 times (SD = 14.86; median = 3.00; IQR 1, 5). The average score on the seven-item assessment based on DSM-IV criteria was 13.38 (SD = 5.99; Table 2), indicating at least some level of marijuana dependence (i.e., reporting an average of at least some degree of symptoms across items). In terms of modes of marijuana use, the most common ways of *ever* having used marijuana were in a bowl (94.1%), followed by in a joint (92.1%), in a waterpipe without tobacco (87.7%), in cigar papers without tobacco (72.4%), ingestion (68.0%), and vaporizing it without tobacco (64.7%). Participants reported *most frequently* using their marijuana by smoking it in a bowl (77.0%), joint (52.4%), or waterpipe without tobacco (44.5%).

In bivariate analyses, correlates of greater number of days of marijuana use included: being male; lower education; more times used per day; more symptoms of dependence; living in an urban community; buying marijuana from a dispensary, a dealer, or someone in the community; possessing a medicinal marijuana card; parental and friend use of marijuana; higher social, enhancement, coping, and expansion use motives; lower perceived harm to health; and less concerns about driving after using marijuana (Tables 1 and 2).

In the multivariable regression (not shown in tables), correlates of number of days of use included: being older ($B = 0.19$, $p = 0.03$); being male ($B = 1.72$, $p = 0.03$); greater symptoms of dependence ($B = 0.22$, $p = 0.005$); residing in a state with recreational marijuana legalized versus no policy ($B = 4.99$, $p = 0.003$); having a medical marijuana card ($B = 5.69$, $p < 0.001$); having parents ($B = 1.02$, $p = 0.01$) and more friends who use marijuana ($B = 1.98$, $p < 0.001$); higher coping motives scores ($B = 0.32$, $p < 0.001$); lower perceived harm to health related to marijuana use ($B = -0.84$, $p = 0.006$); less worry about getting a DUI after using marijuana ($B = 0.68$, $p = 0.03$); and feeling more in control of driving after use ($B = 1.48$, $p < 0.001$; Adjusted R-squared = 0.294).

Driving under the influence (DUI) of marijuana

In this sample, 48.4% reported driving after marijuana use at least once in the past month, with 24.5% reporting driving after marijuana use six or more times in the past month (Table 3). Additionally, 13.0% reporting driving after both marijuana and alcohol use in the past month, with 3.5% reporting driving after both marijuana and alcohol use six or more times in the past month. In terms of being a passenger, 74.0% reported being a passenger in a car when the driver had used marijuana at least once in the past month, with 41.0% reporting being a passenger in this situation six or more times in the past month. Finally, 25.0% had been a passenger when the driver had used both marijuana and alcohol at least once in the past month, with 3.5% reporting being a passenger in this situation six or more times in the past month.

In bivariate analyses, correlates of driving after using marijuana at least once in the past 30 days included: being younger; more days of marijuana use; more symptoms of dependence; buying marijuana from someone in the community; friend use of marijuana; higher social, enhancement, conformity, coping, and expansion use motives; and less concerns about driving after using marijuana (Tables 1 and 2).

In the multivariable regression (not shown in tables), correlates of driving after using marijuana in the past 30 days included: being younger (OR = 0.95, $p = 0.03$); more days of use (OR = 1.04, $p < 0.001$); having more friends who use marijuana (OR = 1.04, $p < 0.001$); higher enhancement motives scores (OR = 1.13, $p = 0.002$); less worry about getting a DUI after using marijuana (OR = 1.17, $p = 0.05$); and feeling more in control of driving after use (OR = 2.39, $p < 0.001$; Nagelkerke R-squared = 0.442). (Excluding the risk perceptions related to getting a

Table 3. High-risk driving behaviors among young adult current marijuana users, $N = 649$.

Driving	*N* (%) *After marijuana use*	*N* (%) *After alcohol & marijuana use*
0 times	335 (51.6)	564 (87.0)
1 time	43 (6.6)	26 (4.0)
2 or 3 times	72 (11.1)	30 (4.6)
4 or 5 times	40 (6.2)	5 (0.8)
6 or more times	159 (24.5)	23 (3.5)
Passenger with driver	*After marijuana use*	*After alcohol & marijuana use*
0 times	169 (26.0)	487 (75.0)
1 time	66 (10.2)	42 (6.5)
2 or 3 times	99 (15.3)	60 (9.2)
4 or 5 times	49 (41.0)	11 (1.7)
6 or more times	266 (41.0)	49 (7.6)

DUI and feeling in control of driving after marijuana use did not significantly change the findings.)

Discussion

The current study sought to describe patterns of marijuana use and identify predictors of higher levels of use and greater odds of DUI of marijuana. Drawing from the Socioecological Model, we examined policy, community, interpersonal, and intrapersonal factors potentially influencing these outcomes. We found several interesting key results.

Of major concern, nearly half of the sample reported driving after marijuana use at least once in the past month, and 13% reported driving after both marijuana and alcohol use. Unfortunately, this survey did not assess driving after alcohol consumption without marijuana use. However, these data suggest that a large proportion of people who would drive after marijuana use would not (or did not) drive after also consuming alcohol, indicating that alcohol is seen as a riskier substance in terms of its impact on driving and risk for DUI or that dual use heightens the perception of risk. A prior study documented similar results, such that 43.9% of male and 8.7% of female first-year college students who had used marijuana in the past month reported driving after using marijuana, with much lower rates of driving after drinking (Asbridge, 2014). Another study of over 2000 young adults found that 15.2% reported any type of DUI, with the greatest proportion (5.02%) reporting driving after marijuana use and 4.34% after using alcohol and 2.41% after using marijuana and alcohol (Li, Simons-Morton, Gee, & Hingson, 2016). In addition, recent research has indicated that marijuana use is also a predictor of DUI of alcohol, and riding with someone DUI of alcohol (Buckley et al., 2017).

Moreover, nearly two-thirds of participants reported feeling in control of their driving and almost half reported little fear of getting a DUI as a result of driving after using marijuana. Similar findings have been documented in young adults in England (Terry & Wright, 2005). Unfortunately, we also documented that three-quarters of our sample had been passengers in a car driven by someone under the influence of marijuana. It is important to note that marijuana and alcohol acutely impairs several driving-related skills in a dose-related fashion, albeit with much less conclusive research regarding the risk of accidents as a result of marijuana use versus alcohol use or use of both (Sewell, Poling, & Sofuoglu, 2009). Regardless, the research has clearly indicated that marijuana use is associated with increased risk for traffic accidents and fatal collisions (Asbridge et al., 2012; Volkow et al., 2014). Thus, this is a major public health issue that requires greater exploration as well as a potential area for interventions to increase awareness of influences of marijuana on driving.

In terms of correlates of DUI, we did not find an association between residing in a state that has legalized recreational or medical marijuana and the outcome of DUI of marijuana, despite previous studies in the literature showing this relationship (Li et al., 2012; Anderson et al., 2013; Couper & Peterson, 2014; Salomonsen-Sautel et al., 2014). This may be due to the timing of the survey and the targeted recruitment of marijuana users across states. We also documented that DUI of marijuana was associated with having more friends who use marijuana, suggesting the importance of social norms and influences. On an intrapersonal level, enhancement motives and less concerns about driving after marijuana use were associated with DUI, perhaps suggesting important intervention targets regarding risk.

With regards to level of marijuana use, this sample of marijuana users reported frequent use (an average of over half of the days). Our findings indicated some common and some distinct predictors of level of use versus DUI. Common predictors of the two outcomes included indicators of dependence (i.e., more days of use, more symptoms of dependence), having more friends who use, higher enhancement motives, and less concern about driving after use. Distinct predictors of more days of use included being older (as opposed to younger for DUI), being male, residing in a state with recreational marijuana legalized, having a medical marijuana card, having parents who use, higher coping motives, and lower perceived harm to health. Indeed, a greater range of variables at the policy, interpersonal, and intrapersonal were correlated with level of use; including level of use in the model predicting DUI may have accounted for some of these other factors, as bivariate findings indicated that higher coping motives was associated with DUI. However, this was not the case for most of these other variables. Indeed, it seems that the risk factors for level of use and DUI are distinct, indicating the need to address these behaviors with distinct intervention messaging.

As with most substance use and in line with prior literature regarding marijuana, men were heavier users of marijuana (SAMHSA, 2015). As expected, state-level legalization of recreational marijuana as well as having a medical marijuana card are both associated with an increased level of use. Perceived social acceptability and marijuana use by parents and friends were also associated with more frequent marijuana use, as prior research has shown (Berg et al., 2015). Greater frequency of use was associated with coping motives, indicating that young adults may use marijuana to "self-medicate" symptoms of anxiety and mood disorders (Bolton, Cox, Clara, & Sareen, 2006; Bolton, Robinson, & Sareen, 2009;

Robinson, Sareen, Cox, & Bolton, 2009). Lower perceived harm of use was also associated with more frequent use, in line with prior research (Berg et al., 2015), thus indicating the importance of quantifying health risks associated with marijuana use in order to deter frequent use.

The current study has important implications for research and practice. In research, continued surveillance of use patterns and perceptions of marijuana and its risks are critical in this rapidly changing policy, market, and social context, particularly as it relates to DUI. Further research is needed to determine what messaging strategies might be effective in altering risk perceptions of marijuana use and its impact on driving. In practice, increased public health efforts must be made to disseminate research findings related to the risks of marijuana use and driving under its influence, with targeted campaigns focusing on young adults, particularly those at greatest risk for use (e.g., males). In particular, the current findings point to the need for multilevel interventions to reduce use and risk of DUI.

Limitations

Despite the strengths of the current study, specifically the inclusion of key multilevel variables and a diverse sample in terms of setting (e.g., state, rural/urban), some key limitations should also be noted. The generalizability of our study is limited given that the sample was focused on young adults and specifically targeted marijuana and tobacco users in order to ensure that the phenomenon of interest was relevant to the sample obtained. We also recruited participants via Facebook, which raises additional concerns regarding the representativeness of our sample of young adult marijuana users to those nationally. We also had a relatively low response rate, which is open to selection bias. Future research should examine these and other related phenomena among a more representative national sample. Specifically, research might explore other dimensions of why and how differing groups of people access and use marijuana as well as prevalence and correlates of DUI of marijuana. Another concern is that the high reported daily use may indicate issues with the validity of the data. Further research is needed to document levels of use among similar populations. Finally, the cross-sectional nature of this study limits the ability to make causal attributions.

Conclusions

In this sample of young adult marijuana users, participants used more than half the days in the past month, using on average six times on the days that they use. In addition, we documented that nearly half of participants reported DUI of marijuana and three-quarters reported being a passenger in a car being driven by someone under the influence. Multilevel risk factors for greater use as well as for DUI of marijuana included residing in a state with recreational marijuana legalized, having a medical marijuana card, social influences using marijuana, using marijuana to cope, lower perceived harm to health; and less concern about driving after marijuana use. Identification of these specific risk factors may inform conceptual models and multilevel interventions to reduce marijuana consumption as well as DUI.

Statement of ethical approval

The [omitted for blind review] Institutional Review Board approved this study, IRB# 00073636.

Funding

This research was supported by the [omitted for blind review].

Competing interests

The authors declare no conflicts of interest.

References

American Psychological Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th. ed.). Washington, DC: American Psychological Association.

Anderson, D. M., Hansen, B., & Rees, D. I. (2013). Medical marijuana laws, traffic fatalities, and alcohol consumption. *Journal of Law & Economics*, *56*(2), 333–369. doi: 10.1086/668812

Asbridge, M. (2014). Driving after marijuana use: The changing face of "impaired" driving. *JAMA Pediatrics*, *168*(7), 602–604. doi: 10.1001/jamapediatrics.2014.83

Asbridge, M., Hayden, J. A., & Cartwright, J. L. (2012). Acute cannabis consumption and motor vehicle collision risk: Systematic review of observational studies and meta-analysis. *British Medical Journal*, *344*, e536. doi: 10.1136/bmj.e536

Bandura, A. (1977). *Social learning theory*. Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (2004). Health promotion by social cognitive means. *Health Education and Behavior*, *31*(2), 143–164. doi: 10.1177/1090198104263660

Berg, C. J. (2016). Preferred flavors and reasons for e-cigarette use and discontinued use among never, current, and former smokers. *International Journal of Public Health*, *61*(2), 225–236. doi: 10.1007/s00038-015-0764-x

Berg, C. J., Stratton, E., Schauer, G. L., Lewis, M., Wang, Y., Windle, M., & Kegler, M. (2015). Perceived harm, addictiveness, and social acceptability of tobacco products and marijuana among young adults: marijuana, hookah, and electronic cigarettes win. *Substance Use and Misuse*, *50*(1), 79–89. doi: 10.3109/10826084.2014.958857

Bolton, J., Cox, B., Clara, I., & Sareen, J. (2006). Use of alcohol and drugs to self-medicate anxiety disorders in a nationally representative sample. *Journal of Nervous and Mental Disorders*, *194*(11), 818–825. doi: 10.1097/01.nmd.0000244481.63148.98

Bolton, J. M., Robinson, J., & Sareen, J. (2009). Self-medication of mood disorders with alcohol and drugs in the National Epidemiologic Survey on Alcohol and Related Conditions. *Journal of Affective Disorders*, *115*(3), 367–375. doi: 10.1016/j.jad.2008.10.003

Brady, J. E., & Li, G. (2014). Trends in alcohol and other drugs detected in fatally injured drivers in the United States, 1999–2010. *American Journal of Epidemiology*, *179*(6), 692–699. doi: 10.1093/aje/kwt327

Brook, J. S., Stimmel, M. A., Zhang, C. S., & Brook, D. W. (2008). The association between earlier marijuana use and subsequent academic achievement and health problems: A longitudinal study. *American Journal on Addictions*, *17*(2), 155–160. doi: 10.1080/10550490701860930

Buckley, L., Bonar, E. E., Walton, M. A., Carter, P. M., Voloshyna, D., Ehrlich, P. F., & Cunningham, R. M. (2017). Marijuana and other substance use among male and female underage drinkers who drive after drinking and ride with those who drive after drinking. *Addictive Behaviors*, *71*, 7–11. doi: 10.1016/j.addbeh.2017.02.016

Campbell, F. A., Tramer, M. R., Carroll, D., Reynolds, D. J., Moore, R. A., & McQuay, H. J. (2001). Are cannabinoids an effective and safe treatment option in the management of pain? A qualitative systematic review. *British Medical Journal*, *323*(7303), 13–16.

Cohn, A., Villanti, A., Richardson, A., Rath, J. M., Williams, V., Stanton, C., & Mermelstein, R. (2015). The association between alcohol, marijuana use, and new and emerging tobacco products in a young adult population. *Addictive Behaviors*, *48*, 79–88. doi: 10.1016/j.addbeh.2015.02.005

Comnes, J. (2016). *Edibles and concentrates already make up a quarter of Oregon's cannabis sales*. Willemette week. Retrieved from http://www.wweek.com/news/2016/09/29/edibles-and-concentrates-already-make-up-a-quarter-of-oregons-cannabis-sales/

Couper, F. J., & Peterson, B. L. (2014). The prevalence of marijuana in suspected impaired driving cases in Washington state. *Journal of Analysis of Toxicology*, *38*(8), 569–574. doi: 10.1093/jat/bku090

Dawson, D. A., Grant, B. F., Stinson, F. S., & Chou, P. S. (2004). Another look at heavy episodic drinking and alcohol use disorders among college and noncollege youth. *Journal of Studies on Alcohol*, *65*(4), 477–488.

D'Souza, D. C. (2007). Cannabinoids and psychosis. *International Review of Neurobiology*, *78*, 289–326. doi: 10.1016/S0074-7742(06)78010-2

Grant, B. F., Dawson, D. A., Stinson, F. S., Chou, S. P., Dufour, M. C., & Pickering, R. P. (2006). The 12-month prevalence and trends in DSM-IV alcohol abuse and dependence - United States, 1991-1992 and 2001-2002 (Reprinted from drug and alcohol dependence, vol 74, pg 223-234, 2004). *Alcohol Research & Health*, *29*(2), 79–91.

Grant, B. F., Hasin, D. S., Chou, S. P., Stinson, F. S., & Dawson, D. A. (2004). Nicotine dependence and psychiatric disorders in the United States: results from the national epidemiologic survey on alcohol and related conditions. *Archives of General Psychiatry*, *61*(11), 1107–1115. doi: 61/11/1107 10.1001/archpsyc.61.11.1107

Gruber, A. J., Pope, H. G., Hudson, J. I., & Yurgelun-Todd, D. (2003). Attributes of long-term heavy cannabis users: a case-control study. *Psychological Medicine*, *33*(8), 1415–1422.

Holmes, L. M., Popova, L., & Ling, P. M. (2016). State of transition: Marijuana use among young adults in the San Francisco Bay Area. *Preventive Medicine*, *90*, 11–16.

Institute of Medicine. (1999). *Marijuana and medicine: Assessing the science base*. Retrieved from http://wwwnapedu/openbookphp?recordid=6376&page=8

Khalsa, J. H., Genser, S., Francis, H., & Martin, B. (2002). Clinical consequences of marijuana. *Journal of Clinical Pharmacology*, *42*(11 Suppl), 7S–10S.

Li, K. G., Simons-Morton, B., Gee, B., & Hingson, R. (2016). Marijuana-, alcohol-, and drug-impaired driving among emerging adults: Changes from high school to one-year post-high school. *Journal of Safety Research*, *58*, 15–20. doi: 10.1016/j.jsr.2016.05.003

Li, M. C., Brady, J. E., DiMaggio, C. J., Lusardi, A. R., Tzong, K. Y., & Li, G. H. (2012). Marijuana use and motor vehicle crashes. *Epidemiology Review*, *34*(1), 65–72. doi: 10.1093/epirev/mxr017

Loflin, M., & Earleywine, M. (2014). A new method of cannabis ingestion: The dangers of dabs? *Addictive Behavior*, *39*(10), 1430–1433. doi: 10.1016/j.addbeh.2014.05.013

Marijuana Business Daily. (2016). *Chart of the week: Sales of marijuana concentrates, edibles surging in Colorado*. Retrieved from http://mjbizdaily.com/chart-of-the-week-sales-of-marijuana-concentrates-edibles-surging-in-colorado/

McLeroy, K. R., Bibeau, D., Steckler, A., & Glanz, K. (1988). An ecological perspective on health promotion programs. *Health Education Quarterly*, *15*(4), 351–377.

Narang, S., Gibson, D., Wasan, A. D., Ross, E. L., Michna, E., Nedelikovic, S. S., & Jamison, R. N. (2008). Efficacy of dronabinol as an adjuvant treatment for chronic pain patients on opioid therapy. *Journal of Pain*, *9*(3), 254–264. doi: 10.1016/j.jpain.2007.10.018

National Conference of State Legislatures. (2016). *State medical marijuana laws*. Retrieved from http://www.ncsl.org/research/health/state-medical-marijuana-laws.aspx

National Highway Traffic Safety Administration. (2016). *Traffic safety facts, 2015 data*. Retrieved from https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812376

Pew Research Center. (2013). *Majority now supports legalizing marijuana*. Retrieved from http://www.people-press.org/2013/04/04/majority-now-supports-legalizing-marijuana/

Ramo, D. E., & Prochaska, J. J. (2012). Broad reach and targeted recruitment using Facebook for an online survey of young adult substance use. *Journal of Medical Internet Research*, *14*(1), e28. doi: 10.2196/jmir.1878

Rath, J. M., Villanti, A. C., Abrams, D. B., & Vallone, D. M. (2012). Patterns of tobacco use and dual use in US young adults: The missing link between youth prevention and adult cessation. *Journal of Environmental and Public Health*, *2012*, 679134. doi: 10.1155/2012/679134

Robinson, J., Sareen, J., Cox, B. J., & Bolton, J. (2009). Self-medication of anxiety disorders with alcohol

and drugs: Results from a nationally representative sample. *Journal of Anxiety Disorders*, *23*(1), 38–45. doi: 10.1016/j.janxdis.2008.03.013

Salomonsen-Sautel, S., Min, S. J., Sakai, J. T., Thurstone, C., & Hopfer, C. (2014). *Trends in fatal motor vehicle crashes before and after marijuana commercialization in Colorado* (vol 140, pg 137, 2014). *Drug and Alcohol Dependence*, *142*, 360–360. doi: 10.1016/j.drugalcdep.2014.07.004

Santaella-Tenorio, J., Mauro, C. M., Wall, M. M., Kim, J. H., Cerda, M., Keyes, K. M., Hasin, D. S., Galea, S. S., & Martins, S. S. (2017). US traffic fatalities, 1985-2014, and their relationship to medical marijuana laws. *American Journal of Public Health*, *107*(2), 336–342. doi: 10.2105/AJPH.2016.303577

Sewell, R. A., Poling, J., & Sofuoglu, M. (2009). The effect of cannabis compared with alcohol on driving. *American Journal on Addictions*, *18*(3), 185–193. doi: 10.1080/10550490902786934

Sidney, S. (2002). Cardiovascular consequences of marijuana use. *Journal of Clinical Pharmacology*, *42*(11 Suppl), 64S–70S.

Simons, J., Correia, C. J., & Carey, K. B. (2000). A comparison of motives for marijuana and alcohol use among experienced users. *Addictive Behaviors*, *25*(1), 153–160.

Sola, K. (2016). *Legal U.S. marijuana market will grow to $7.1 billion in 2016: Report. Forbes*. Retrieved from http://www.forbes.com/sites/katiesola/2016/04/19/legal-u-s-marijuana-market-will-grow-to-7-1-billion-in-2016-report/#5af522e3568d

Stinson, F. S., Ruan, W. J., Pickering, R., & Grant, B. F. (2006). Cannabis use disorders in the USA: Prevalence, correlates and co-morbidity. *Psychological Medicine*, *36*(10), 1447–1460. doi: 10.1017/S0033291706008361

Substance Abuse and Mental Health Services Administration. (2013). *Results from the 2012 national survey on drug use and health: Summary of national findings, NSDUH series H-46*. HHS Publication No. (SMA) 13-4795. Rockville, MD: Substance Abuse and Mental Health Services Administration.

Substance Abuse and Mental Health Services Administration. (2014). *Results from the 2013 national survey on drug use and health: Summary of national findings, NSDUH Series H-48*. HHS Publication No. (SMA) 14-4863. Rockville, MD: Substance Abuse and Mental Health Services Administration.

Substance Abuse and Mental Health Services Administration. (2015). *Results from the 2014 national survey on drug use and health*. Rockville, MD: Substance Abuse and Mental Health Services Administration.

Terry, P., & Wright, K. A. (2005). Self-reported driving behaviour and attitudes towards driving under the influence of cannabis among three different user groups in England. *Addictive Behaviors*, *30*(3), 619–626. doi: 10.1016/j.addbeh.2004.08.007

United States Census Bureau. (2016). *American community survey*. Washington, DC: United States Census Bureau. Retrieved from https://www.census.gov/programs-surveys/acs/

Volkow, N., Baler, R., Compton, W., & Weiss, S. (2014). Adverse health effects of marijuana use. *New England Journal of Medicine*, *370*(23), 2219–2227.

Zhang, Z. F., Morgenstern, H., Spitz, M. R., Tashkin, D. P., Yu, G. P., Marshall, J. R., Hsu, T. C., & Schantz, S. P. (1999). Marijuana use and increased risk of squamous cell carcinoma of the head and neck. *Cancer Epidemiology, Biomarkers and Prevention*, *8*(12), 1071–1078.