

ORIGINAL ARTICLE

The Impact of Marijuana Legalization on Adolescent Use, Consequences, and Perceived Risk

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ABSTRACT

Background: Currently, only four states have legalized recreational marijuana use for adults over 21 years of age. Therefore, little is known about the influence that legalization will have on adolescent marijuana use. *Objectives:* This study examines how marijuana legalization has impacted the frequency and consequences of adolescent use in a sample of participants in a school-based, substance use intervention. We hypothesized that adolescents enrolled in the intervention in years after marijuana legalization would present with more problematic use compared to those enrolled prior, and that changes in the perceived risk of marijuana would be a mechanism of problematic use. *Methods:* Participants were 262 students enrolled in a school-based substance use intervention in 2010 to 2015. The Customary Drinking and Drug Use Record, Alcohol and Drug Use Consequences Questionnaire, and a decisional balance matrix were used to assess marijuana frequency, negative consequences, and perceived risk of use. A mediation model was used to test the degree to which marijuana legalization may lead to increased frequency and consequences of use through perceived risk. *Results:* Findings indicated a significantly positive correlation between marijuana-related consequences and perceived risk post legalization. Despite relatively equal use between both groups, adolescents in the legalization group experienced higher levels of perceived risk and increased negative consequences. *Conclusions/Importance:* Due to the rising legalization status of marijuana in the United States, it is imperative that psychoeducation is provided to adults and adolescents about the consequences of underage marijuana use.

KEYWORDS

Recreational marijuana legalization; recreational marijuana; perceived risk; adolescent marijuana use; marijuana consequences; marijuana frequency of use; school-based intervention

Background

In recent years, recreational marijuana legalization has raised great controversy on its effects on adolescent marijuana use, consequences and perceived risk (Anderson & Rees, 2014). Chronic marijuana use can result in impaired cognition, damage to developing areas of the brain, depression, and suicidal ideation in adolescents (Durkin, 2014; Golub, Dunlap, & Benoit, 2010; Volkow, Baler, Compton, & Weiss, 2014). Similarly to alcohol use, marijuana was once a difficult substance to access and possession was associated with a variety of legal consequences. Today, the negative implications of marijuana use have diminished and access has increased substantially (Anderson & Rees, 2014). Additionally, many studies have shown that the legalization of marijuana has contributed to the general continuation of marijuana use and decrease in alcohol consumption rates, resulting in less traffic fatalities, decreased suicide rates, and variable marijuana-use-related patterns of behavior among adolescents (Anderson & Rees, 2014; Anderson, Rees, & Sabia, 2014). Consequently, adolescents' perceptions of marijuana use have likely shifted to a more positive

view while concerns of adolescent marijuana-use consequences have increased (Palamar, Ompad, & Perkova, 2014; Wall et al., 2011).

Despite the consensus that marijuana use is impairing to adolescents (National Institute of Drug Abuse, 2008), there have been mixed results on the relationship between marijuana legalization and subsequent rates of use and consequences among adolescents. Some studies have reported little evidence of a correlation between marijuana legalization and increased marijuana use and consequences of use (Anderson, Hansen, & Rees, 2013). For instance, Anderson and Rees (2014) reported a decline in marijuana use among high school students from 2007–2009 and then an increase from 2009–2011 before and after medical marijuana legalization in California in 2009. Consequently, we are interested in comparing the rates of marijuana use, consequences of use, and perception of use before and after the legalization among adolescents in a school-based substance use intervention, Project READY (Reducing the Effects of Alcohol and Drugs among Youth).

Marijuana legalization and use

To date, only four states (i.e., Colorado, Washington, Oregon, and Alaska) have legalized recreational marijuana use for adults over the age of 21. Therefore, little is known about the impact that legalization will have on adolescent marijuana use behaviors. The impact of medical marijuana legalization laws, which predates recreational marijuana legalization, and are more prevalent in the literature (Cerdeña et al., 2012; Choo et al., 2014; Harper, Strumpf, & Kaufman, 2012; Wall et al., 2011); however, these studies yield mixed results. Cerdeña et al. (2012) found that medical marijuana legalization resulted in significantly higher rates of marijuana use, abuse, and dependence, although this sample only included adults 18 and over. Similarly, Wall and colleagues (2011) found that medical marijuana legalization resulted in an increase in adolescent use. Despite some findings of increased use in adolescent and young adult populations as a result of medical marijuana legalization, other studies have found that medical marijuana laws resulted in a decrease in adolescent marijuana use overall (Choo et al., 2014; Harper et al., 2012). These mixed findings about the impact of medical marijuana legalization on adolescent marijuana use make it difficult to delineate the influence of recreational marijuana legalization on adolescent use.

Marijuana legalization and perceived risk

Along with marijuana use, an adolescent's perception of the risk of use is another important factor to consider when studying the impact of marijuana legalization on adolescents. Findings are also mixed in regards to how recreational marijuana legalization has impacted adolescent risk perception of use. Wall and colleagues (2011) examined adolescent risk perception in states with and without medical marijuana laws. Results indicated that adolescents living in states with medical marijuana laws reported lower risk perceptions than adolescents living in states without such laws. However, adolescents in states with medical marijuana laws also demonstrated lower levels of perceived risk prior to legalization. Therefore, differing attitudes of adolescents in states with marijuana laws may be a product of the overall environment of these states rather than the legalization of marijuana per se.

To date, two studies have examined the impact of recreational marijuana legalization on future intentions to use. Palamar, Ompad, and Perkova (2014) examined intentions to use marijuana if it became legalized among marijuana using and nonusing adolescents. Ten percent of nonusers reported intention to use if marijuana became legal, and those that were current smokers indicated that they would smoke marijuana more often if it became

legal. It can be hypothesized that intention rose due to a decrease in perceived riskiness of marijuana use if it was legalized. Lastly, a recent study conducted in Tacoma, Washington involved parents and adolescents following the legalization of recreational marijuana use. Results indicated that legalization resulted in little change in favorable marijuana use attitudes or intentions to use (Mason, Hanson, Fleming, Ringle, & Haggerty, 2015). Consistent with the studies on marijuana use, the impact of legalization on perceived risk has mixed findings.

Marijuana legalization and consequences

As more states shift to legalization, more public health-related concerns have come to light. In general, states with legalized marijuana tend to have higher rates of use, even prior to legalization, which may lead to acute intoxication affecting driving abilities and unintentional consumption of marijuana products (Wilkinson, Yarnell, Radhakrishnan, Ball, & D'Souza, 2016). Additionally, many investigators have studied the impact of marijuana legalization on frequency of use and perceived risk, but few have examined how the legalization of marijuana has impacted marijuana-related consequences for adolescents. Of these few adolescent studies, Jaffe and Klein (2010) found that implementation of medical marijuana policy lead to a reduction in recognition of the problematic consequences of marijuana use, such as decreases in short-term memory and reduction in motivation. Also, early marijuana use (i.e., before age 17) may contribute to attention impairments and subsequent negative school performance in adolescents (Pardini et al., 2015). Despite these negative consequences, adolescents continued to perceive their use as less risky than prior to medical marijuana legalization. Pacula, Powell, Heaton, & Sevigny (2015) found that states with legalized medical marijuana dispensaries may put youth at a risk of both increased use and related consequences. Also, because adolescents may not view marijuana use as risky behavior, when it could in fact be connected to drug relapse rates, it may be harder to maintain sobriety or even abstain from other substance use (Hopfer, 2014). To our knowledge, there are limited studies that examine the impact of medical and recreational marijuana legalization on adolescent consequences, particularly due to the recent nature of legality laws. The current study will seek to expand on this area of research.

Objectives

The current study examines how marijuana legalization has impacted the frequency and consequences of marijuana use among adolescents enrolled in a school-based substance use intervention. Specifically, we hypothesize

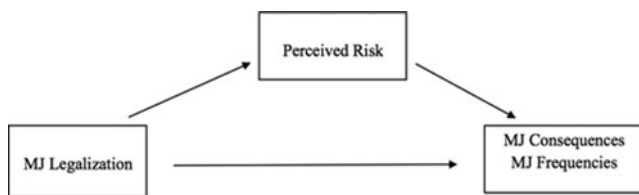


Figure 1. The relationship between MJ legalization on consequences and frequencies of use through perceived risk.

that adolescents enrolled in the study post legalization would demonstrate more problematic use, as defined by higher frequency of use and a greater amount of negative consequences, compared to those enrolled prior to legalization.

We also hypothesized that perceived risk would mediate the relationship between marijuana legalization and frequency and consequences of use. Specifically, adolescents who received the intervention prior to legalization would perceive marijuana use as less risky than adolescents who received the intervention postlegalization, which would result in a higher frequency of use and a greater overall number of consequences. The graphical representation of our model is shown in [Figure 1](#).

Methods

Power analysis

A power analysis was conducted to determine the sample size necessary to achieve adequate statistical power. The analysis was conducted using G*Power with an effect size of $f^2 = .15$, an alpha level of .05, and power set at .95. Results indicated that a minimum of 115 participants would be required to have sufficient power to detect a medium effect.

Participants

Participants were students recruited from high schools in the greater Seattle area to participate in Project READY (Reducing the Effects of Alcohol and Drugs on Youth). Project READY is a school-based substance use intervention utilizing Motivational Interviewing principles and techniques to promote behavior and attitude change (Stewart, Felleman, & Arger, 2015). Participants were self-referred or identified by school staff as problematic substance users. These included students who had openly violated school substance use policies by possessing alcohol, marijuana, or other drugs on campus; students who were reported by parents, peers, school staff, or self-report to be substance users; students who experienced negative consequences outside of school, such as arrest, hospitalization, or accidents. All students were screened after

referral for use of alcohol, marijuana, or other illicit drugs. Those who reported any substance use within the three months prior to beginning the intervention were eligible for enrollment. Referred students who did not report substance use in the prior three months were excluded. The only other exclusion criteria were being dis-enrolled in school between referral and the start of the intervention. Project READY has demonstrated effectiveness in reducing marijuana use and consequences up to 16 weeks postintervention in several studies (Serafini, Shipley, & Stewart, 2015; Stewart, Arlt, Felleman, Athenour, & Arger, 2015; Hall, Stewart, Arger, Athenour, & Effinger, 2014)

Participants consisted of 262 students from five high schools in the greater Seattle area. Of the 262 participants, 55% were male and 36% were females. Ages ranged from 13 to 19 years, ($M = 16$). Ethnic demographics indicated that 45% of the participants identified as Caucasian, 19% Hispanic, 14% Asian/Pacific Islander, 14% Multi-Ethnic, 8% African American, and less than 1% Native American. Of the 262 participants, 144 students received the intervention prior to the legalization of marijuana and 118 received the intervention postlegalization.

Procedure

Seattle Pacific University's Institutional Review Board, as well as the school district's Data, Research, and Testing Board approved the current study prior to recruitment and administration of the intervention. Throughout the course of the intervention, participants met with an assigned interventionist weekly at their respective high schools in a private meeting room. During intake, interventionists explained the purpose of Project READY and informed consent was obtained from the students. Once participants consented to participate in the intervention, an identification number was assigned to de-identify each participant from personal information. This study used data collected from assessments administered at session one, prior to receiving any other part of the intervention. Participants were able to withdraw their consent for participation at any time without any penalty.

Measures

Perceived risk

A decisional balance matrix was used to assess adolescent's perceived pros and cons of continued use, and pros and cons of making changes. Lauby, Bond, Eroğlu, & Batson (2006) demonstrated a strong relationship between cons of behavior on a decisional balance and perceived risk in an HIV study. Next, participants rated the importance of each of these advantages and disadvantages on a 1 to 7 scale, with 1 being "not important at all" and 7 being

“*extremely important.*” Perceived risk was determined by examining the number of cons that participants listed for marijuana use.

Frequency of use

The Customary Drinking and Drug Use Record (CDDR; Brown et al., 1998) is a 101-item measure to assess adolescents’ current (i.e., past three months) and lifetime substance use behaviors, including quantity and frequency. Other domains measure level of involvement, withdrawal characteristics, dependence, and negative consequences. The CDDR has shown to be reliable and valid when used with substance-abusing adolescents and community samples of adolescents, with Cronbach’s alpha ranging from .72 to .89 (Brown et al., 1998). For the current study, a behavioral count of marijuana use over the last three months served as a frequency variable.

Consequences of use

The Alcohol and Drug Use Consequences Questionnaire (ADUCQ; Hall et al. 2014) is a 51-item measure used to assess psychological, behavioral and relational substance use consequences. Individuals were asked to report the number of times in the past year that they have experienced a variety of consequences on a Likert-scale, with 0 being “*never*” and 4 being “*more than 10 times.*” Few studies have examined the psychometric properties of the ADUCQ. However, the Cronbach’s alpha coefficient for this study was .97, indicating excellent internal consistency. In the current study, the total number of consequences endorsed for marijuana use was a dependent variable.

Results

Data analysis

A mediation model was used to test the degree to which marijuana legalization (X, MJLEGAL) may lead to increased frequency and consequences (Y, MJCONSQ) of adolescent marijuana use through perceived risk (M, CONSUSE). One mediated path allowed for the examination of indirect and direct paths from the independent variable of marijuana legalization through perceived risk to the dependent variables of frequency and consequences of use. Specifically, we ran two separate analyses, changing only the dependent variable in each model. We analyzed the strength and significance of the indirect, direct, and total effects. The indirect effect is statistically significant if the 95% bias-corrected bootstrap confidence interval for the parameter estimate does not contain zero.

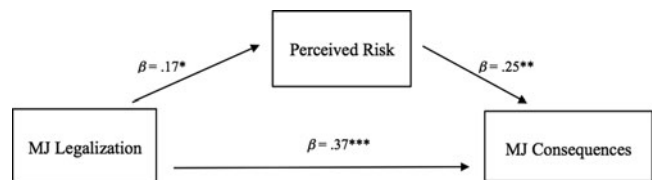


Figure 2. Standardized beta coefficients demonstrating the relationship between MJ legalization on consequences of use through perceived risk. * $p < .05$. ** $p < .01$. *** $p < .001$.

Bootstrap analysis, a nonparametric sampling procedure, was used to test the significance of the indirect effect. Because we interpreted standardized regression weights (and PROCESS provides only unstandardized values), we saved the scale scores as z-scores prior to the analysis. These standardized weights are shown in Figure 2.

Mediational analysis

Using PROCESS Macro (Hayes, 2013), coefficients for the indirect, direct, and total effect were computed. The means and standard deviations of the variables both pre- and postlegalization are shown in Table 1. Results (depicted in Figure 2) suggested that 3% of the variance in perceived risk and 22% of the variance in consequences of use were accounted for by the variables in the model. The outcome variable of frequency of use was not significant and therefore not included in this section. The total indirect effect of marijuana legalization status on consequences of use through perceived risk was statistically significant ($B = 3.73$, $CI_{95} = .33-9.55$). The positive valence of the indirect effect suggests that those using marijuana postlegalization were 3.73 units higher in their negative consequences than those using prior to legalization, as a result of the effect of marijuana legalization status on the mediator, perceived risk, which in turn influenced marijuana use. Therefore, we can assume that the strength of the indirect effect differs as a function of the mediator, such that marijuana legalization was related to increased adolescent perceived risk of use. Also, the total effect of marijuana legalization was statistically significant ($B = 32.81$, $p < .001$, $CI_{95} = 19.23-46.40$). That is, the effect of marijuana legalization status on consequences of

Table 1. Means and standard deviations of variables.

	Consequences		Frequency of use		Perceived risk	
	Mean	SD	Mean	SD	Mean	SD
MJlegal	80.17 ^a	44.05	13.36	9.8	4.38 ^b	2.38
MJlllegal	49.47 ^a	39.93	13.99	11.27	3.64 ^b	1.90

Note: ^{a,b} Mean differences significant at $p < .01$.

use yielded a statistically significant effect when it was the only predictor of marijuana use. Additionally, there was evidence that participants' marijuana use differed as a function of marijuana legalization status when perceived risk was statistically controlled (i.e., the direct effect). Interpreting the results suggests that adolescents using marijuana postlegalization perceived a greater risk of use, which was associated with increased marijuana-related negative consequences.

Conclusions/importance

The current study examined the effect of marijuana legalization on frequency and consequences of adolescent marijuana use in a school-based substance use intervention prior to and post marijuana legalization. Despite local recreational legalization, marijuana continues to be illegal for underage users and its possession and use violate school norms of health, safety and discipline. The impact of legalization on the process of referral, teen attitudes about use and level of problem recognition were important targets of this research. Adolescents in our school sample were identified as problematic users by school personnel without the aid of screening tools, while this referral process yielded adolescents who were using marijuana at equivalent frequencies pre- and post-Washington state legalizations, the referral process yielded adolescents who perceived marijuana as more risky and, perhaps partly because of this perception, were experiencing increased negative consequences of marijuana use. These findings are important for school personnel and treatment providers who strive to motivate adolescents to change marijuana use patterns in the face of legalization. Efforts to reduce underage marijuana use by highlighting risks and consequences are likely working and should continue postlegalization. This mirrors the public health approaches to reducing underage alcohol and tobacco use which have been successful despite legal adult consumption. We first hypothesized that participants enrolled in the intervention post marijuana legalization would demonstrate increased frequency and consequences of use than those enrolled prior to marijuana legalization. Additionally, we hypothesized that perceived risk would mediate this relationship. Results indicated that there was a significant positive correlation between consequences of marijuana use and perceived risk post marijuana legalization. Additionally, we hypothesized that adolescents who received the intervention postlegalization would demonstrate increased frequency of use, increased consequences, and lower levels of perceived risk. Despite relatively equal frequency of marijuana use among all participants, adolescents enrolled in the intervention postlegalization experienced higher levels of perceived

risk and increased negative consequences, compared to adolescents enrolled prior to legalization. It appears that adolescents enrolled in the intervention postlegalization have higher insight into their problematic use; however, this did not decrease their number of marijuana use consequences.

Recent literature has reported mixed findings regarding increased adolescent marijuana use and perceived risk post marijuana legalization (Anderson & Rees, 2014; Anderson, Rees, & Sabia, 2014; Durkin, 2014; Friese & Grube, 2013); the current study demonstrates increased negative consequences postlegalization. Although results did not indicate increased marijuana use postlegalization, there was a statistically significant model of increased consequences through perceived risk. Conclusively, marijuana legalization had a positive correlation with perceived risk, and a subsequent effect on marijuana use, such that adolescents enrolled postlegalization experienced more consequences.

Limitations

There were a few limitations with the current study. Due to the nature of the intervention, random sampling was not implemented because students were referred by school faculty or self-referred. Thus, all of the students referred to the intervention were identified as problematic substance users. Therefore, those in the study may have elevated patterns of risky use as compared to other substance-using adolescents. This may limit the generalizability of our results to high school students who do not endorse similar risky marijuana use patterns and consequences. Also, a majority of our sample were Caucasian males. While the literature shows that middle to late adolescent males tend to use substances at higher rates compared to females and experience more consequences due to higher rates of explicit externalizing behaviors (Chen & Jacobson, 2012; Silverthorn & Frick, 1999), the generalizability of our results to both female and also ethnic minority adolescents who may have different use patterns and subsequent consequences is limited (Stewart, Moise-Campbell, Chapman, Varma, & Lehinger, 2016). A final limitation is that this study was conducted in Washington State. Washington has a lengthy history of medical marijuana legalization, as well as its geographic location in the Pacific Northwest, where decriminalization of marijuana by police authorities predates recreational marijuana legalization (Aggarwal, Kyashna-Tocha, & Carter, 2007; Single, 1989). Adolescents in this state and region are therefore more likely to be exposed by relative permissive attitudes towards marijuana by adults in their social environment (Mason et al., 2015).

Implications

Although the literature reports few findings of marijuana legalization on frequency of adolescent marijuana use and consequences (Choo et al., 2014), our findings reveal consequences above and beyond increased use. Adolescents are experiencing interpersonal, health, and disciplinary consequences, resulting in increased juvenile delinquency, dropout rates, interpersonal, and health problems (Oetzel & Duran, 2004; Slade, 2004; Weden & Zabin, 2005). Consequences of marijuana use can have long-lasting effects on adolescent functioning and potential for success. Adolescent serving systems including schools, medical homes, community mental health, and juvenile justice should be prepared to monitor their screening, brief intervention, and referral processes for potential changes in adolescent attitudes and behavior in the face of marijuana legalization. For example, the problematic adolescent substance users seen in the present study demonstrated a change in perception of the risk of marijuana use. As motivational interviewing providers this knowledge will help us construct interventions at the individual and system level to respond to new public health messaging about marijuana risk.

Future directions

According to the results of the current study, adolescents are experiencing a higher number of negative consequences due to their marijuana use postlegalization. Due to the rising legalization status of marijuana in the United States, it is imperative that psychoeducation is provided to teachers, counselors, parents, and adolescents in order to gain an understanding of marijuana use consequences. Psychoeducation should include the impact of underage marijuana use on physical, psychological, and interpersonal consequences. Similar to laws restricting minor use of alcohol, recreational marijuana use is limited to adults over the age of 21. Therefore, it is highly recommended that educators and counselors continue to discuss the restrictions around marijuana legalization in relation to the prevention of adolescent use.

The results of our study contribute to the mixed findings of the impact of marijuana legalization on adolescent frequency of use, negative consequences, and perceived risk. More studies should be conducted to further examine these variables in adolescent populations to understand the impact of recreational marijuana legalization. It would also be beneficial to examine rates of initiation of use after marijuana legalization to determine the impact that legalization has on adolescents who previously abstained from use. Studies should assess varying consequences of marijuana use in addition to

increased use postlegalization, as the literature appears to explore increased use exclusive of consequences and perceived risk. Also, consequences and increased use may have a bidirectional relationship on perceived risk of marijuana use; however, more information is needed to clarify this relationship. Additionally, future studies should operationally define perceived risk and delineate perceived risk versus actual risk. Similarly, it would be helpful for researchers to examine other factors contributing to increased consequences postlegalization, such as increased monitoring at school and home.

Lastly, because our adolescent sample was primarily Caucasian males, studies should be conducted to examine gender and ethnic differences in marijuana use, negative consequences, and perceived risk of use as a result of recreational marijuana legalization. It would be valuable to see how postlegalization effects may be exhibited among an increasingly varied sample, and the subsequent resulting differences in consequences and frequency of use. Moreover, it would help inform how to provide more effective forms of interventions across groups.

Declaration of interest

The authors declare that they have no conflict of interest. The authors alone are responsible for the content and writing of the article.

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