



Published in final edited form as:

J Adolesc Health. 2019 June ; 64(6): 807–809. doi:10.1016/j.jadohealth.2018.11.019.

Patterns of Co-Occurring Modes of Marijuana Use Among Colorado High School Students

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Abstract

Purpose.—To understand how adolescents concurrently use different modes of marijuana consumption.

Methods.—Using data from the 2017 Healthy Kids Colorado Survey, we examined how modes of marijuana use (smoking/ingesting/vaping/dabbing/other) co-occur. We estimated the prevalence of all combinations of these modes among adolescents who reported past 30-day marijuana use (n=3,618). We then estimated the prevalence any use of each mode by each mode usually used.

Results.—Forty-one percent reported only smoking, another 10% reported smoking and dabbing, and 9.8% reported smoking and ingesting. Only about 10% used a combination of modes that did not include smoking. Smoking was the most common additional mode for all other usual modes of consumption.

Conclusions.—Smoking in combination with dabbing and/or ingesting, were the most common multi-mode patterns of use. Nearly all adolescents who use marijuana smoke some or most of the time.

Keywords

Marijuana; modes of consumption; adolescent marijuana use

Introduction

Most US states have medical marijuana laws, and a growing number have legalized adult recreational marijuana (1). In Colorado, recreational marijuana was legalized in 2012, and retail sales were implemented in 2014. As a result, many different modes of marijuana use

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Conflicts of Interest: None.

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are now available to the general public, each of which has unique health risks (2). Smoking marijuana may increase risk for certain cancers and pulmonary problems (3-5). Health effects of other modes are less well understood. Ingesting marijuana can make it difficult to titrate the dose, and lead to overintoxication (5). Furthermore, vaporizing and dabbing are two distinct modes that involve inhaling vapors. Traditionally, vaporizing involves heating flower or concentrates in an electronic device, which carries some risk for device malfunctions/explosions that can cause injuries (5). Dabbing, which uses convective heating methods and products like wax, shatter, or hash oil, is the most potent mode of marijuana consumption and may increase risk for cannabis use disorders (5). Given that each mode of use may be associated with unique health risks, combining multiple modes may exacerbate harm. Multi-mode use, particularly concentrated modes, may present acute risk of overuse that results in unintended intoxication/injury and long-term risk for cannabis use disorders. Understanding how different modes are combined by adolescents who use marijuana is important for developing tailored interventions (6).

Limited research has focused on the epidemiology of different modes of marijuana use and their co-use among adolescents. One study identified profiles of young adults that either used plant-based marijuana in combination with concentrates or edibles (7). However, given developmental differences, these co-use patterns are not necessarily the same among adolescents. We aim to better understand how adolescents are combining different modes of marijuana use in a US state that has legalized medical and recreational marijuana use for adults.

Methods

Healthy Kids Colorado Survey (HKCS).

The HKCS is a biennial, paper-based survey of Colorado middle and high school students, that uses a two-stage stratified cluster design (8). Public schools were randomly selected, and classrooms were sampled within schools. All students within sampled classrooms were invited to participate. We used the HKCS data from 9th-12th grade students in fall 2017. We only included respondents who received the supplemental marijuana module (randomly administered to half of participants) and reported any past 30-day marijuana use (20% prevalence; n=3,618).

Modes of Marijuana Use.

Modes were assessed via two questions: “During the past 30 days, how did you use marijuana? (Select all that apply),” and “During the past 30 days, how did you most often use marijuana?” Both questions had five response options: “smoked it,” “ate it,” “vaporized it,” “dabbed it,” and “used it some other way.” We generated a binary indicator for any use of each mode, a variable indicating each possible combination of modes used, and a categorical variable indicating usual mode of use.

Analysis.

We used Stata 14.2 (9) to estimate the weighted prevalence of each combination of specific modes. Then, we estimated prevalence and 95% confidence intervals for the use of an

additional mode among individuals who reported usually using a different mode. Design and post-stratification weights were applied to represent Colorado public school student enrollment.

Results

Patterns of Co-Occurring Modes of Use.

One-half of adolescents who used marijuana reported using a single mode, primarily smoking (41.1%; Table 1). Smoking and dabbing (10.0%) and smoking and ingesting (9.8%) were the next most common patterns, followed by smoking, ingesting, and dabbing (7.9%) and smoking, ingesting, vaping, and dabbing (5.1%). No other pattern of co-occurring modes of marijuana use had a prevalence greater than 5%. There were no highly prevalent patterns of modes that did not include smoking.

Secondary Modes of Use.

Smoking was the most common usual mode and the most common other mode of use for all non-smoking usual modes (Table 2). Among those who usually smoked, dabbing (28.9%) and ingesting (25.7%) were the most common other modes used. Those who usually dabbled had the highest prevalences of using all other secondary modes. Across all usual modes, the secondary use of “other” modes was the least common.

Discussion

We sought to understand patterns of co-occurring modes of marijuana use among adolescents in Colorado. Half of adolescents used a single mode of consumption. Smoking was the most commonly used mode for both single and multiple mode use. Smoking in combination with dabbing and/or ingesting were the most common multi-mode patterns.

Less than 10% of high school students who used marijuana did not smoke. There is a continued dominance of smoking as the usual mode of marijuana consumption in contrast with national declining trends of cigarette smoking among adolescents (10). As much as declines in cigarette use are attributable to effective public health messaging, adolescents may not be connecting the perceived harms of smoking tobacco to smoking marijuana. While our study could not test this hypothesis, future surveillance should address the perceived harms of different modes of cannabis use. If this is the case, public health messaging around the harms of smoking both tobacco and marijuana need to be revised to appropriately communicate its risks.

There is substantial use of multiple modes. Mode-specific prevention efforts are incomplete due to how common multi-modal use is. Continued surveillance of emerging modes of use, including dapping, vaping, and edibles, is critical to determining if future declines in smoking marijuana would be attribute to increases in an alternative mode of use as has been suggested by some adult studies (5).

Limitations of this study highlight the need for more extensive surveillance data regarding different modes of marijuana use. Many of the usual mode groups were small in our second

analysis. We had no information about what “other” modes of use adolescents in Colorado use, which highlights that additional data are needed. Few surveys assess mode of marijuana consumption, which is a key component of the health risks conferred by marijuana use. Without better surveillance data, we cannot effectively study the consequences of marijuana consumption for adolescents. Continued surveillance of modes of consumption is essential for effective prevention messaging.

Acknowledgments

Funding: Data was collected under Colorado Department of Public Health and Environment contracts (Brooks-Russell, PI). This work was supported by the National Institute on Drug Abuse (5T32DA007292-25: Schneider and Tormohlen; K01DA031738: Johnson).

Abbreviations:

HKCS Healthy Kids Colorado Survey

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Implications and Conclusions

Adolescents are using multiple modes of cannabis, and smoking is the most common. Adolescents do not seem to be completely replacing smoking with non-combustible modes, though these results cannot rule out partial replacement. Campaigns to prevent adolescent cannabis use should continue a focus on smoking as a predominant mode of use.

Table 1.

Prevalences of All Patterns of Co-Occurring Modes of Marijuana Use in the Past 30 Days (n = 3,556).

Number of Modes	Specific Modes	Prevalence and 95% CI	
1	Smoked	41.1% (37.6, 44.7)	
	Ingested	4.6% (3.3, 6.5)	
	Vaped	1.9% (1.3, 2.8)	
	Dabbed	2.6% (1.8, 3.7)	
	Other	1.1% (0.7, 1.8)	
2	Smoked, Ingested	9.8% (8.4, 11.9)	
	Smoked, Vaped	3.3% (2.4, 4.5)	
	Smoked, Dabbed	10.0% (8.4, 11.9)	
	Smoked, Other	0.2% (0.1, 0.5)	
	Ingested, Vaped	0.4% (0.2, 1.0)	
	Ingested, Dabbed	0.6% (0.3, 1.2)	
	Ingested, Other	<0.1% (0.0, 0.1)	
	Vaped, Dabbed	0.2% (0.1, 0.5)	
	Vaped, Other	--	
	Dabbed, Other	0.1% (0.02, 0.8)	
3	Smoked, Ingested Vaped	2.2% (1.4, 3.3)	
	Smoked, Ingested, Dabbed	7.9% (6.9, 9.0)	
	Smoked, Ingested, Other	0.6% (0.3, 1.2)	
	Smoked, Vaped, Dabbed	3.1% (2.3, 4.0)	
	Smoked, Vaped, Other	0.1% (0.03, 0.2)	
	Smoked, Dabbed, Other	0.5% (0.3, 0.9)	
	Ingested, Vaped, Dabbed	<0.1% (0.0, 0.1)	
	Ingested, Vaped, Other	--	
	Ingested, Dabbed, Other	<0.1% (0.0, 0.1)	
	Vaped, Dabbed, Other	<0.1% (0.0, 0.05)	
	Smoked, Ingested, Vaped, Dabbed	5.1% (4.1, 6.4)	
	Smoked, Ingested, Vaped, Other	0.3% (0.1, 0.8)	
	Smoked, Ingested, Dabbed, other	0.7% (0.4, 1.2)	
4	Smoked, Vaped, Dabbed, Other	0.3% (0.1, 0.6)	
	Ingested, Vaped, Dabbed, Other	--	
	5	All	3.4% (2.6, 4.4)

Note. A "--" indicates that there were no individuals in that cell in the unweighted data. 62 individuals in the sample were missing information on any mode of use.

Table 2.

Prevalence (95% CI) of Using Each Mode among Individuals who Usually Used a Different Mode of Marijuana Consumption in the Past 30 Days

		Among individuals who usually...			
		Smoked	Ingested	Vaped	Dabbed
Prevalence of also having ...	Smoked	--	44.2% (35.1, 53.3)	54.6% (42.6, 66.5)	65.3% (57.8, 72.7)
	Ingested	25.7% (22.2, 29.1)	--	31.3% (17.8, 44.7)	36.3% (27.4, 45.2)
	Vaped	15.3% (13.0, 17.5)	10.2% (4.9, 15.5)	--	27.1% (19.1, 35.1)
	Dabbed	28.9% (26.3, 31.6)	14.2% (8.6, 19.8)	17.9% (8.1, 27.8)	--
	Other	4.7% (3.6, 5.9)	3.1% (0.0, 6.7)	3.4% (0.4, 6.3)	13.3% (7.0, 19.7)

Note. Sample sizes for each usual mode of use were as follows: smoked n=2,485, ate n=289, vaped n=139, and dabbed n=268.