

# UCSF

## UC San Francisco Previously Published Works

### Title

Cannabis use among adolescents and emerging adults who use e-cigarettes: Findings from an online, national U.S. Sample

### Permalink

<https://escholarship.org/uc/item/5tr2f0kv>

### Authors

Croker, James A  
Werts, Miranda  
Couch, Elizabeth T  
et al.

### Publication Date

2023-05-01

### DOI

10.1016/j.addbeh.2023.107620

Peer reviewed



Published in final edited form as:

*Addict Behav.* 2023 May ; 140: 107620. doi:10.1016/j.addbeh.2023.107620.

## Cannabis use among adolescents and emerging adults who use e-cigarettes: Findings from an online, national U.S. Sample

James A. Croker III, PhD<sup>1</sup>, Miranda Werts<sup>2</sup>, Elizabeth T. Couch, RDH MS<sup>2</sup>, Benjamin W. Chaffee, DDS, MPH, PhD<sup>1,2</sup>

<sup>1</sup>Center for Tobacco Control Research and Education, Cardiovascular Research Institute, University of California San Francisco, San Francisco, CA, USA.

<sup>2</sup>Division of Oral Epidemiology and Dental Public Health, School of Dentistry, University of California San Francisco, San Francisco, CA, USA.

### Abstract

Concurrent use of e-cigarettes and cannabis among adolescents and emerging adults is a growing public health concern. More research is needed describing cannabis use among adolescents and emerging adults who vape. The objective of this study was to characterize cannabis use among young people who had ever used e-cigarettes (age 14–20), particularly their use of blunts and liquid cannabis vape (LCV) products. Using cross-sectional data from a national online survey, we describe their patterns of cannabis use, detail their use of flavored cannabis and tobacco products, and estimate associations of demographic factors and other current substance use behaviors with levels of blunt and LCV use. Of the 2253 respondents in the sample, 1379 (61%) reported some form of cannabis use in the past 30 days, among whom 80% used flavored cannabis (including edibles). Significant associations with current cannabis use were observed on several demographic measures, with current cannabis blunt use more frequent among participants not in school, non-Hispanic Blacks, multiracial respondents, and those whose incomes do not meet their expenses. Other than income, demographic characteristics were generally not associated with LCV use frequency. Use of other substances was associated with more frequent use of both blunts and LCV in the past 30 days, and enrollment in college or the military seems somewhat protective for emerging adults. These findings suggest a need for tailored prevention efforts among high-risk adolescents and emerging adults, potential regulation of added flavors in commercialized cannabis products, and stronger enforcement of retail restrictions for individuals under age 21 more broadly.

### Keywords

cannabis abuse; electronic nicotine delivery systems; vaping; flavor additives; adolescent behavior

### 1.1 Introduction:

Cannabis use among adolescents and emerging adults is a major public health concern. In 2019, 37% of high school students reported lifetime cannabis use, and 22% reported

use in the past 30 days.<sup>1,2</sup> While minors (individuals under age 21) do not have access to legal cannabis in any state outside of a controlled medical program, minors in states with legalized medical or recreational cannabis report greater access to cannabis products.<sup>3,4</sup> The potential harms of cannabis use for adolescents are well established,<sup>5–9</sup> specifically the potential for long-term effects of regular use on adolescent brain development.<sup>8</sup> Negative effects of cannabis use among adolescents include difficulty with cognitive functions like learning, thinking, and problem solving, in addition to memory loss, difficulty maintaining attention, and impaired coordination.<sup>10</sup> Moreover, adolescents engaging in heavy cannabis use have increased risks for mental health problems, including anxiety, depression, substance use disorder, psychosis, and schizophrenia.<sup>11,12</sup>

Cannabis and tobacco products are growing increasingly intertwined from regulatory and public health perspectives, with increasing concurrent use (i.e., use of both substances in the same time frame), including using tobacco products to deliver cannabis in both combustible and aerosolized forms.<sup>4,13–18</sup> While reasons for cannabis and tobacco use among this population may differ, there are likely some shared predisposing factors. For example, added flavors, particularly sweet flavors, may motivate youth initiation and continued use of tobacco and e-cigarettes.<sup>19–23</sup> Individuals using cannabis are exposed to added flavors through flavored wrapping papers for joints, flavored cigars for blunts, and flavor enhanced cannabis leaf or flower. Limited data exist on the prevalence of flavored cannabis use, with one smaller study suggesting flavor use similar to some tobacco products.<sup>24</sup>

The combined use of cannabis and tobacco in blunt form is a major factor in the high prevalence of cigar use among adolescents,<sup>25</sup> especially among African American youth.<sup>26–28</sup> Blunts are particularly attractive to adolescents and emerging adults who use cannabis as the cigars used for blunts are inexpensive and widely available, specific brands have shell perforations and other design elements making them ideal for blunt rolling, blunts are also often used publicly by celebrities, and blunt smoking is often seen as a social activity.<sup>29–34</sup>

As the cannabis industry has expanded, new products similar in design and function to e-cigarettes have become broadly available and use among this population is increasing.<sup>14–16</sup> In 2019, past 30-day prevalence of cannabis vaping was reported by 14% of 12<sup>th</sup> graders, and past 30-day prevalence for all high school students increased significantly over one year.<sup>35</sup> New commercial “e-cannabis” products allow for non-combustible means of consuming cannabis liquid, oil, and wax (hereafter termed “Liquid Cannabis Vape” or LCV), often with added flavors. LCV products, like e-cigarettes, may also be perceived as safer and more discreet than combustible cannabis.<sup>36</sup> LCV products are not harmless; cannabis vaping produces greater physiological and psychological effects compared with traditional smoking.<sup>37</sup> Moreover, in 2019 illicit LCV products containing vitamin E acetate were implicated in an outbreak of severe lung injury, raising concerns about potential health effects of cannabis vaping.<sup>38</sup>

This study characterizes patterns of cannabis use via blunts and LCV among adolescents and emerging adults who use e-cigarettes. It uses cross-sectional data from a national (U.S.)

online survey of individuals aged 14–20 years who report repeated use of e-cigarettes to estimate relative risk of more frequent blunt and LCV use.

## 2.1 Methods:

This study used a cross-sectional national online survey of U.S. adolescents (14–17 years) and emerging adults (18–20 years) who reported ever using e-cigarettes at least 3 times. A threshold of 3 times was set as an inclusion criterion to help assure the study population included participants familiar with e-cigarettes from repeated use.<sup>39</sup> Participants were recruited from existing, actively managed market research panels aggregated by Qualtrics. Those potentially meeting predetermined eligibility criteria were provided a description of the study's goals, expectations, and voluntary nature and then given the option to participate. Of 8860 who completed screener questionnaires, 2712 participants met eligibility criteria (e-cigarette use 3 times and age 14–20), and 2253 completed the survey. Surveys were completed between March 18, 2021, and April 25, 2021. The median survey completion time was 9 minutes. Participants were offered incentives that varied by panel but typically consisted of points redeemable for awards. Approval for this research was granted by the Internal Review Board at the University of California San Francisco.

### 2.1.1 Data

The survey included adaptive questioning measures related to the use of e-cigarettes and other tobacco products, cannabis, and alcohol, in addition to flavored commercial product use and sociodemographic characteristics. State and personal identifiers were not collected.

### 2.1.2 Independent Variables

Demographic variables included constructed categorical indicators for age and school enrollment status (age 14–17 and enrolled in school; age 18 or older and enrolled in high school; age 18 or older and enrolled in college, training program, or active-duty military; any respondent not enrolled school, college, or military), gender (female, male, non-binary or refused), race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, Asian or Pacific Islander, Multiracial, or some other race), and income sufficiency (“Live comfortably”; “Meet needs with a little left over”; “Just meet basic expenses”; “Do not meet basic expenses”). Dichotomous indicators were also constructed for total lifetime use of e-cigarettes (<100 times; 100 times).

To assess lifetime substance ever-use we used the question, “Please select which of the following products you have ever used,” to construct dichotomous indicators of use for the various substance use categories. Similarly, to assess past 30-day substance use we used the question “Of the products you just selected, please indicate how many days you used that product in the past 30 days.” We also used these measures to construct dichotomous indicators of use (no use in past 30 days; used 1 or more days in past 30 days) for the various substances used. The substance use categories included in the analysis were cannabis (joints, blunts, waterpipes, dry leaf vapes, liquid/oil/wax vapes/dabs, edibles), e-cigarettes (any type of e-cigarette, including stick-like disposable, cigalike disposable, reusable pod, mod, rebuildable, and pen-like refillable devices), smokeless tobacco products (chewing tobacco,

moist snuff, and snus), combustible tobacco products (cigarettes, tobacco only cigars, and hookah/waterpipes), and alcohol (beer, wine, and liquor).

The survey included an adaptive format where respondents who reported past 30-day use of a given product were then asked follow-up questions on the use of flavors in those products. For consistency in assessing the use of flavored products we transformed more detailed flavored product reports into a more general form (i.e., any flavored product use, no flavor or unflavored product, or I don't know).

### 2.1.3 Dependent Variables:

The survey included measures capturing cannabis use by modality. To capture blunt use, the question “In the past 30 days, have you used marijuana (cannabis) smoked as a blunt (a cigar with marijuana inside)” was used. To capture LCV use, the question “In the past 30 days, have you used any marijuana (cannabis) oil, wax, or liquid to vape or dab” was used. Outcomes for this analysis included constructed measures for past 30-day frequency of cannabis use by modality (cannabis smoked as a blunt in the past 30 days and LCV used in past 30 days). We began by creating a nominal variable where frequency of product use in the past 30 days was grouped into five categories for analysis, “no [blunt/LCV] use ever”, “no [blunt/LCV] used in the past 30 days”, “used [blunts/LCV] 1–5 days”, “used [blunts/LCV] 6–19 days”, and “used [blunts/LCV] 20 or more days”. This approach for presenting prevalence of past 30-day cannabis use as nominal variable follows the approach used by the CDC to present tobacco surveillance data from the National Youth and Tobacco Survey, with the addition of including a category for those who have ‘never used’ blunts or LCV for a more complete quantitative analysis.<sup>40</sup>

### 2.1.4 Statistical Approach:

This study followed an exploratory approach to describe cannabis use patterns. First, descriptive statistics were produced for past 30-day cannabis use, and for demographic variables. Univariate analyses were performed to describe the sample. Group differences on cannabis use for discrete variables were identified using chi-square tests. Descriptive statistics were also produced for flavor use across products. Finally, multinomial logistic regressions were used to estimate relative risk ratios of the constructed categories for cannabis use frequency in the past 30 days via blunts and LCV, while adjusting for school enrollment status by age group, other demographic characteristics, and co-use of other substances. Only 1 observation was missing across the co-variables used in multivariable analysis; thus, models were fitted with listwise deletion. The Benjamini-Hochberg Procedure (BHP) for controlling the false discovery rate was used.<sup>41</sup> An adjusted  $p$  value of .05 or less was considered statistically significant on all two-tailed tests. All data management and statistical analyses were performed using Stata 17.1 (StataCorp). Reporting is consistent with the CHERRIES checklist for cross-sectional studies.<sup>42</sup>

## 3.1 Results:

Of the 2253 respondents in the sample, 1379 (61%) reported using cannabis in the past 30 days (Table 1). Most of the sample (73%) were emerging adults aged 18–20 years. The

largest share of respondents was age 18 and over and enrolled in college, a training program, or the military (36%), followed by adolescents enrolled in middle school or high school (27%), and respondents 18 and over and in high school (16%). Most respondents were female (65%), while 32% were male, and 3% were non-binary or refused the question. The majority of respondents were also non-Hispanic Whites (57%), while 19% were Hispanic, 9% were non-Hispanic Blacks, and Asians/Pacific Islanders, multiracial respondents, and those of some other race were each roughly 5%. Most reported their personal income was sufficient, allowing them to live comfortably (41%) or meeting their basic needs with a little left over (30%).

Cannabis use in our sample was more common among emerging adults, non-Hispanic Blacks, multiracial (2 or more non-Hispanic) respondents, and those whose incomes do not meet their expenses (Table 1). In terms of other substance use behaviors, self-reported use of multiple substances in the past 30 days was common: those using cannabis in the past 30 days were more likely than those not using cannabis to report using e-cigarettes, other forms of tobacco, and alcohol in the past 30 days.

Cannabis use in multiple modalities was common in this sample (Table 2). In total, 61% of respondents reported cannabis use in the past 30 days. Of these, 75% reported smoking cannabis in joints, spliffs, or a small pipe, 62% reported smoking blunts, and 70% reported using liquid cannabis vape (LCV). Respondents using cannabis in the past 30 days were also likely to use e-cigarettes (85%) and alcohol (75%). Among those using other forms of tobacco, the prevalence of cannabis use was 85% among those using cigars, 89% among those using hookah/waterpipe, and above 70% among those using the other tobacco products examined.

Across cannabis and tobacco products, flavored product use was common among those reporting past 30-day use (Table 3). In total, nearly 80% of those using cannabis indicated consuming any flavored cannabis product (including edibles). Other sources of flavored products included flavored wrapping paper for joints or spliffs, flavored cigars for blunts, or flavored cannabis liquid, oil, or wax for vaping or dabbing. Among all those reporting past 30-day cannabis use, 36% used flavored blunts and 36% used flavored LCV. However, 57% of those reporting past 30-day blunts use, used flavored cigars, and 51% of those who report past 30-day LCV use, used flavored cannabis liquid, oil, or wax for vaping. Flavored product use was also high across the various tobacco products used by those reporting cannabis use: for example, 92% of those using e-cigarettes and cannabis reporting any flavored e-cigarette use.

Race/ethnicity, school or program enrollment, and recent substance use were correlated with past 30-day blunt use frequency, as modeled with multinomial logistic regression (Table 4). Relative to having tried but not used blunts in the past 30 days, never using blunts was less likely among emerging adults out of high school than among adolescents in middle or high school. Asian/Pacific Islander ( $1.87[1.17;3.00]$ ) and Hispanic ( $1.50[1.12;2.02]$ ) respondents were more likely to have never used blunts compared to non-Hispanic White respondents. Respondents who used e-cigarettes and alcohol in the past 30 days were less likely to have never used blunts.

Relative to having tried but not used blunts in the past 30 days, emerging adults enrolled in college, a training program, or the military were less likely to have used blunts 1–5 days compared to adolescents in middle or high school ( $0.73[0.52;1.02]$ ). Multiracial respondents were more likely to use blunts ( $2.53[1.38;4.65]$ ) 1–5 days compared to non-Hispanic White respondents. Respondents using e-cigarettes, tobacco only cigars, hookah/water pipes, and alcohol were also more likely to use blunts 1–5 days than 0 days compared to those not using these products.

Multiracial ( $3.20[1.51;6.81]$ ); non-Hispanic Black ( $2.60[1.40;4.81]$ ); and Hispanic ( $2.08[1.32;3.30]$ ) respondents were more likely to have used blunts 6–19 days compared to non-Hispanic White respondents. Greater likelihood of using blunts 6–19 days was also observed for those indicating their income was insufficient. Respondents using e-cigarettes, tobacco only cigars, hookah/water pipes, and alcohol were also more likely to use blunts 6–19 days.

Emerging adults enrolled in college, a training program, or the military had lower risk of using blunts 20 days compared to adolescents in middle and high school. Multiracial ( $3.54[1.79;6.99]$ ) and non-Hispanic Black ( $3.47[2.04;5.92]$ ) respondents had the greatest risk of using blunts 20 days compared to non-Hispanic White respondents. Those whose income was insufficient and respondents using e-cigarettes, tobacco only cigars, hookah/water pipes, and alcohol were also more likely to use blunts 20 days.

School or program enrollment and recent substance use, but not gender or race/ethnicity, were correlated with past 30-day Liquid Cannabis Vape (LCV) use frequency, as modeled with multinomial logistic regression (Table 5). Relative to having tried but not used LCV in the past 30 days, those who reported using e-cigarettes had statistically lower likelihood of never using LCV ( $0.58[0.45;0.76]$ ), while those using smokeless tobacco had greater likelihood ( $1.73[1.16;2.59]$ ) of never using LCV.

Relative to having tried but not used LCV in the past 30 days, those not enrolled in school ( $0.53[0.34;0.80]$ ) and emerging adults enrolled in college, a training program, or the military ( $0.64[0.45;0.90]$ ) were less likely to use LCV 1–5 days compared to adolescents enrolled in school. Those using hookah/waterpipes and alcohol had greater likelihood of using LCV 1–5 days.

Greater likelihood of using LCV 6–19 days was observed among those whose income was ‘just enough’ to meet daily expenses ( $2.08[1.35;3.21]$ ). Greater likelihood of using LCV 6–19 days was also observed for those using tobacco only cigars, hookah/waterpipe, and alcohol.

Lower risk of using LCV 20 days was observed for emerging adults enrolled in college, a training program, or the military compared to adolescents enrolled in school. Respondents who reported that their income does not meet daily expenses ( $2.08 [1.21;3.57]$ ) were more likely to use LCV 20 days than 0 days, as were those using e-cigarettes, tobacco only cigars, hookah/waterpipes, and alcohol.

## 4.1 Discussion:

This study gives greater insight into the behaviors of adolescents and emerging adults who use e-cigarettes as they relate to cannabis use generally, and specific insights into the use of added flavors in various cannabis products and the demographic factors associated with more frequent use of blunts and LCV. This study adds to a growing body of literature exploring the intersection of tobacco and cannabis use,<sup>43–48</sup> demonstrating higher rates of multiple substance use among this high-risk population than generally observed in studies prior to Covid-19,<sup>48,49</sup> and offering important new findings for policy makers and prevention professionals.

In particular, this study allows for detailing cannabis and other substance use (i.e., tobacco and alcohol use) behaviors among adolescents and emerging adults already engaged in e-cigarette use, behaviors that could place them at elevated risk for experiencing the negative physiological and sociological effects of long-term drug and alcohol use.<sup>50,51</sup> Based on these results, not only is cannabis use widespread among adolescents and emerging adults who use e-cigarettes, but use of flavored cannabis products among those using cannabis approaches or exceeds flavored tobacco among those who report using various tobacco products. Cannabis consumption co-administered with tobacco (e.g., blunts) or by aerosolizing devices resembling e-cigarettes (e.g., LCV) is also common and represents a potential area for better coordination between tobacco and cannabis control policies and regulations to prevent use among minors.

Cannabis continues to be the most commonly used controlled substance by adolescents and emerging adults.<sup>52</sup> As this study affirms, despite age restrictions, individuals under age 21 are consuming cannabis through a variety of modalities, including more traditional combustible methods like blunts, and via a growing number of new commercial ‘e-cannabis’ products like LCV. Previous research details how commercialization of cannabis directly drives greater use among this population by increasing access to products via diversion,<sup>53,54</sup> and indirectly through marketing and messaging framing cannabis use as safe, medically necessary, or normatively acceptable for recreation.<sup>55</sup> This was seen in restrictive Covid-19 policies, when in-person classes for adolescents and emerging adults were suspended, but in-person medical and recreational cannabis sales continued.<sup>56,57</sup> It is possible some adolescents and emerging adults have access to cannabis-based products through their state’s medical cannabis program.<sup>58</sup> The present study did not ask about medical cannabis use. However, the American Academy of Pediatrics stands in opposition to cannabis use in patients under age 21, save for ‘life-limiting or seriously debilitating conditions.’<sup>59</sup>

Flavors are a plausible factor contributing to the use of both cannabis and tobacco. We found similarly high levels of flavored product use across both cannabis and tobacco products, demonstrating the appeal of flavors. It seems plausible that many of the reasons youth previously reported for using flavored tobacco hold for flavored cannabis, given the high flavored product use among those using cannabis and the similarity in delivery. Flavor is also a major driver in cigar use initiation<sup>60</sup> and a way to enhance or improve the taste of cannabis when used in blunts.<sup>31,61</sup> Our research shows commercialized cannabis products are easily accessed by minors despite retail restrictions. The cannabis industry may also be



targeting this population with campaigns on social media marketing flavored ‘aromatherapy’ products, while minimizing the fact they also contain cannabis.<sup>62</sup>

Co-administration of cannabis and tobacco via blunts in this study is strongly associated with use of tobacco only cigars, reinforcing findings indicating blunt use is a driver of cigar use among this population.<sup>25</sup> What is unclear is whether one precedes the other and acts as a catalyst for use, given use of cigarettes or other tobacco products can enhance or prolong the high associated with cannabis use.<sup>13,29,30</sup> Other studies have also suggested misconceptions about the risks of blunt use and its status as a form of both cannabis and tobacco.<sup>63–67</sup>

The study does not assess risk perceptions of blunt use relative to other forms of cannabis use. However, we found greater LCV use than blunt use, raising the question of whether adolescents and emerging adults who use e-cigarettes because of perceived safety relative to combustible cigarettes, are also using LCV as a ‘safer’ alternative to smoking cannabis.

Here, LCV use is second only to any form of smoked cannabis use (i.e., joints, spliffs, or small pipes), and higher than blunt use. As observed elsewhere, those who reported more frequent LCV use also reported greater polysubstance use,<sup>68</sup> however we did not see similar differences associated with sex/gender. Given the associations here between LCV use and age/school enrollment status, regulators should consider tighter retail restrictions on LCV products. At the same time, appropriate substance use prevention programming is necessary to address increasing LCV use.

#### 4.1.1 Limitations:

The limitations come from the cross-sectional, market panel survey design. Online research panels are used widely, including in tobacco control research<sup>69</sup> and among adolescents and emerging adults.<sup>70,71</sup> While panel members may differ from the general U.S. population,<sup>72</sup> participants reflect diversity in income, race/ethnicity, and geography. While restricting the sample to include only those using e-cigarettes reduces generalizability to the population at large, it remains meaningful to consider substance use among adolescents and emerging adults already engaged in tobacco use. The questionnaire did not ask about medical cannabis program enrollment, obtaining cannabis from a dispensary, or intended medical use. State of residence was not recorded.

## 5.1 Conclusion:

This study characterizes cannabis use in a national sample of adolescents and emerging adults who report ever using e-cigarettes, describing use of flavored cannabis and tobacco products, and estimating the risk of past 30-day cannabis use via blunts and LCV at higher frequency. We found high levels of cannabis, tobacco, and alcohol use, raising concerns about product availability to adolescents and emerging adults. Flavored cannabis and tobacco use was high across all products, indicating flavors are widely accessible and a potential driver in co-use. We found greater risk of blunt use at higher frequencies for minority youth and those experiencing income insufficiency, factors associated with psychosocial distress, and found increased odds when using tobacco and alcohol. Regulators must focus on interrupting access to these substances by minors and better regulation of flavors in cannabis products.

## Funding:

This work was supported by the National Institutes of Health Postdoctoral Training in Tobacco Control [Grant No. T32CA113710] and the National Institutes of Health and Food and Drug Administration [Grant No. U54HL147127].

## Abbreviations:

LCV                      liquid cannabis vape

## References:

1. Jones CM, Clayton HB, Deputy NP, et al. Prescription opioid misuse and use of alcohol and other substances among high school students – Youth Risk Behavior Survey, United States, 2019. *MMWR Suppl.* 2020 Aug 21;69(1):38–46. [PubMed: 32817608]
2. NIDA. Vaping of marijuana on the rise among teens. National Institute on Drug Abuse website. <https://nida.nih.gov/news-events/news-releases/2019/12/vaping-of-marijuana-on-the-rise-among-teens>. December 18, 2019. Accessed February 26, 2022.
3. Cerdá M, Mauro C, Hamilton A, et al. Association between recreational marijuana legalization in the United States and changes in marijuana use and cannabis use disorder from 2008 to 2016. *JAMA Psych.* 2020;77(2):165–171. doi:10.1001/jamapsychiatry.2019.3254
4. McDonald EA, Popova L, Ling PM. Traversing the triangulum: the intersection of tobacco, legalised marijuana and electronic vaporisers in Denver, Colorado. *Tob Control.* 2016 Oct;25(Suppl 1):i96–i102. doi:10.1136/tobaccocontrol-2016-053091. [PubMed: 27697954]
5. Batalla A, Bhattacharyya S, Yücel M, et al. Structural and functional imaging studies in chronic cannabis users: a systematic review of adolescent and adult findings. *PLoS One.* 2013;8(2):e55821. [PubMed: 23390554]
6. Committee on Substance Abuse Committee on Adolescence. The impact of marijuana policies on youth: clinical, research, and legal update. *Pediatrics.* 2015;135(3):584–587. doi:10.1542/peds.2014-4146. [PubMed: 25624383]
7. Substance Abuse and Mental Health Services Administration (US); Office of the Surgeon General (US). Facing Addiction in America: The Surgeon General’s Report on Alcohol, Drugs, and Health [Internet]. Washington (DC): US Department of Health and Human Services; 2016 Nov. <https://www.ncbi.nlm.nih.gov/books/NBK424857/>. November 2016. Accessed February 25, 2022.
8. National Academies of Sciences Engineering and Medicine, “The health effects of cannabis and cannabinoids: Current state of evidence and recommendations for research,” Washington, DC, 2017.
9. Tucker JS, Pedersen ER, Seelam R, Dunbar MS, Shih RA, D’Amico EJ. Types of cannabis and tobacco/nicotine co-use and associated outcomes in young adulthood. *Psychol Addict Behav.* 2019;33(4):401–411. doi:10.1037/adb0000464. [PubMed: 30985164]
10. Volkow ND, Swanson JM, Evins AE, et al. Effects of cannabis use on human behavior, including cognition, motivation, and psychosis: a review. *JAMA Psych.* 2016;73(3):292–297.
11. Hasin DS, Saha TD, Kerridge BT, et al. Prevalence of marijuana use disorders in the United States between 2001–2002 and 2012–2013. *JAMA Psychiatry.* 2015;72(12):1235–42. [PubMed: 26502112]
12. Winters KC, Lee C-YS. Likelihood of developing an alcohol and cannabis use disorder during youth: association with recent use and age. *Drug Alcohol Depend.* 2008;92(1–3):239–247. [PubMed: 17888588]
13. Schauer GL, Rosenberry ZR, Peters EN. Marijuana and tobacco co-administration in blunts, spliffs, and mulled cigarettes: a systematic literature review. *Addict Behav.* 2017;64:200–211. doi:10.1016/j.addbeh.2016.09.001. [PubMed: 27654966]
14. Smith DM, Hyland A, Kozlowski L, O’Connor RJ, Collins RL. Use of inhaled nicotine and cannabis products among adults who vape both substances. *Subst Use Misuse.* 2022;5:1–10. doi:10.1080/10826084.2021.2019773.

15. Dunbar MS, Davis JP, Tucker JS, Seelam R, Shih R, D'Amico EJ. Developmental trajectories of tobacco/nicotine and cannabis use and patterns of product co-use in young adulthood. *Tob Use Insights*. 2020;13:1179173X20949271. doi:10.1177/1179173X20949271.
16. Lanza HI, Barrington-Trimis JL, McConnell R, et al. Trajectories of nicotine and cannabis vaping and polyuse from adolescence to young adulthood. *JAMA Netw Open* 2020;3(10):e2019181. doi:10.1001/jamanetworkopen.2020.19181. [PubMed: 33021651]
17. Krishnan-Sarin S, Jackson A, Morean M, et al. E-cigarette devices used by high-school youth. *Drug Alcohol Depend*. 2019;194:395–400. doi:10.1016/j.drugalcdep.2018.10.022. [PubMed: 30497057]
18. Nguyen N, Barrington-Trimis JL, Urman R, et al. Past 30-day co-use of tobacco and marijuana products among adolescents and young adults in California. *Addict Behav*. 2019;98:106053. doi:10.1016/j.addbeh.2019.106053. [PubMed: 31357072]
19. US Department of Health and Human Services. E-cigarette Use Among Youth and Young Adults: A Report of the Surgeon General. Atlanta, GA: US Department of Health and Human Services, CDC; 2016. [https://www.cdc.gov/tobacco/data\\_statistics/sgr/e-cigarettes/pdfs/2016\\_sgr\\_entire\\_report\\_508.pdf](https://www.cdc.gov/tobacco/data_statistics/sgr/e-cigarettes/pdfs/2016_sgr_entire_report_508.pdf). Accessed February 25, 2022.
20. Ambrose BK, Day HR, Rostron B, et al. Flavored tobacco product use among US youth aged 12–17 years, 2013–2014. *JAMA*. 2015;314(17):1871–1873. doi:10.1001/jama.2015.13802. [PubMed: 26502219]
21. Leventhal AM, Miech R, Barrington-Trimis J, Johnston LD, O'Malley PM, Patrick ME. Flavors of e-cigarettes used by youths in the United States. *JAMA*. 2019;322(21):2132–2134. doi:10.1001/jama.2019.17968. [PubMed: 31688891]
22. Gentzke AS, Wang TW, Jamal A, Park-Lee E, Ren C et al. Tobacco product use among middle and high school students, United States, 2020. *MMWR*. 2020;69(50):1881–1888. [PubMed: 33332300]
23. Nguyen N, Wong M, Delucchi K, Halpern-Felsher B. Adolescents' and young adults' perceptions of risks and benefits differ by type of cannabis products. *Addict Behav*. 2022;131:107336. doi:10.1016/j.addbeh.2022.107336. Epub 2022 Apr 12. [PubMed: 35436697]
24. Werts M, Urata J, Watkins SL, Chaffee BW. Flavored cannabis product use among adolescents in California. *Prev Chronic Dis*. 2021 Jun 3;18:E54. doi:10.5888/pcd18.210026. [PubMed: 34081578]
25. Kong G, Cavallo DA, Goldberg A, LaVallee H, Krishnan-Sarin S. Blunt use among adolescents and young adults: informing cigar regulations. *Tob Regul Sci*. 2018;4(5):50–60. doi:10.18001/TRS.4.5.5.
26. Schauer GL, Rosenberry ZR, Peters EN. Marijuana and tobacco co-administration in blunts, spliffs, and mulled cigarettes: A systematic literature review. *Addict Behav*. 2017;64:200–211. doi:10.1016/j.addbeh.2016.09.001. [PubMed: 27654966]
27. Mantey DS, Onyinye O, Montgomery L. Prevalence and correlates of daily blunt use among U.S. African American, Hispanic, and White adults from 2014 to 2018. *Psychol Addict Behav*. 2021;35(5):514–522. doi:10.1037/adb0000702.
28. Montgomery L, Plano Clark VL, Twitty D, Budney AJ, Prochaska JJ, Winhusen T. Is it “loud” enough?: A qualitative investigation of blunt use among African American young adults. *J Ethn Subst Abuse*. 2022;21(2):747–761. doi:10.1080/15332640.2020.1801548. [PubMed: 32744476]
29. Lipperman-Kreda S, Lee JP, Morrison C, Freisthler B. Availability of tobacco products associated with use of marijuana cigars (blunts). *Drug Alcohol Depend*. 2014;134:337–342. [PubMed: 24290366]
30. Sifaneck SJ, Johnson BD, Dunlap E. Cigars-for-blunts: choice of tobacco products by blunt smokers. *J Ethn Subst Abuse*. 2005;4(3–4):23–42.
31. Giovenco DP, Miller Lo EJ, Lewis J, Delnevo CD. “They’re pretty much made for blunts”: product features that facilitate marijuana use among young adult cigarillo users in the United States. *Nicotine Tob Res*. 2017;19(11):1359–1364. [PubMed: 27613943]
32. Dunlap E, Johnson BD, Benoit E, Sifaneck SJ. Sessions, cyphers, and parties: settings for informal social controls of blunt smoking. *J Ethn Subst Abuse*. 2005;4(3–4):43–79. [PubMed: 16537328]

33. Malone RE, Yerger V, Pearson C. Cigar risk perceptions in focus groups of urban African American youth. *J Subst Abuse*. 2001;13(4):549–561. [PubMed: 11775082]
34. Miech RA, Patrick ME, O’Malley PM, Johnston LD, Bachman JG. Trends in reported marijuana vaping among US adolescents, 2017–2019. *JAMA*. 2020;323(5):475–476. doi:10.1001/jama.2019.20185 [PubMed: 31848566]
35. Wang TW, Gentzke AS, Creamer MR, et al. Tobacco product use and associated factors among middle and high school students — United States, 2019. *MMWR Surveill Summ*. 2019;68(No. SS-12):1–22. doi:10.15585/mmwr.ss6812a.
36. US Centers for Disease Control and Prevention. Quick facts on the risks of e-cigarettes for kids, teens, and young adults. CDC website. 2022. [https://www.cdc.gov/tobacco/basic\\_information/e-cigarettes/Quick-Facts-on-the-Risks-of-E-cigarettes-for-Kids-Teens-and-Young-Adults.html](https://www.cdc.gov/tobacco/basic_information/e-cigarettes/Quick-Facts-on-the-Risks-of-E-cigarettes-for-Kids-Teens-and-Young-Adults.html). Accessed February 26, 2022.
37. Spindle TR, Cone EJ, Schlienz NJ, et al. Acute effects of smoked and vaporized cannabis in healthy adults who infrequently use cannabis: a crossover trial. *JAMA Netw Open*. 2018;1(7):e184841–e184841. doi:10.1001/jamanetworkopen.2018.484 [PubMed: 30646391]
38. Blount BC, Karwowski MP, Shields PG, et al. Vitamin E Acetate in bronchoalveolar-lavage fluid associated with EVALI. *N Engl J Med*. 2020 Feb 20;382:697–705. doi:10.1056/NEJMoa1916433. [PubMed: 31860793]
39. Chaffee BW, Halpern-Felsher B, Croker JA, Werts M, Couch ET, Cheng J. Preferences, use, and perceived access to flavored e-cigarettes among United States adolescents and young adults. *Drug Alcohol Depend Rep*. 2022;3:100068. doi:10.1016/j.dadr.2022.100068. [PubMed: 35757567]
40. Cooper M, Park-Lee E, Ren C, Cornelius M, Jamal A, Cullen KA. Notes from the field: e-cigarette use among middle and high school students - United States, 2022. *MMWR Morb Mortal Wkly Rep*. 2022;71:1283–1285. doi:10.15585/mmwr.mm7140a3. [PubMed: 36201370]
41. Thissen D, Steinberg L, Kuang D. Quick and easy implementation of the Benjamini-Hochberg Procedure for controlling the false positive rate in multiple comparisons. *J Educ Behav Stat*. 2001;81:332–342. doi:10.3102/10769986027001077.
42. Eysenbach G Improving the quality of Web surveys: the Checklist for Reporting Results of Internet E-Surveys (CHERRIES). *J Med Internet Res*. 2004 Sep 29;6(3):e34. doi:10.2196/jmir.6.3.e34. Erratum in: doi:10.2196/jmir.2042. [PubMed: 15471760]
43. Reboussin BA, Wagoner KG, Ross JC, Suerken CK, Sutfin EL. Tobacco and marijuana co-use in a cohort of young adults: patterns, correlates and reasons for co-use. *Drug Alcohol Depend*. 2021;227:109000. doi:10.1016/j.drugalcdep.2021.109000. [PubMed: 34507062]
44. Crane NA, Langenecker SA, Mermelstein RJ. Risk factors for alcohol, marijuana, and cigarette polysubstance use during adolescence and young adulthood: a 7-year longitudinal study of youth at high risk for smoking escalation. *Addict Behav*. 2021;119:106944. doi:10.1016/j.addbeh.2021.106944. [PubMed: 33872847]
45. Cho J, Goldenson NI, Kirkpatrick MG, Barrington-Trimis JL, Pang RD, Leventhal AM. Developmental patterns of tobacco product and cannabis use initiation in high school. *Addiction*. 2021;116(2):382–393. doi:10.1111/add.15161. [PubMed: 32533801]
46. Seaman EL, Stanton CA, Edwards KC, Halenar MJ. Use of tobacco products/devices for marijuana consumption and association with substance use problems among U.S. young adults (2015–2016). *Addict Beh*. 2020;102:106133. doi:10.1016/j.addbeh.2019.106133.
47. Tucker JS, Pedersen ER, Seelam R, Dunbar MS, Shih RA, D’Amico EJ. Types of cannabis and tobacco/nicotine co-use and associated outcomes in young adulthood. *Psychol Addict Behav*. 2019;33(4):401–411. doi:10.1037/adb0000464.
48. D’Amico EJ, Rodriguez A, Dunbar MS, et al. Sources of cannabis among young adults and associations with cannabis-related outcomes. *Int J Drug Policy*. 2020. 86:102971. doi:10.1016/j.drugpo.2020.102971. [PubMed: 33038599]
49. Harrell MB, Clendennen SL, Sumbe A, Case KR, Mantey DS, Swan S. Cannabis vaping among youth and young adults: a scoping review. *Curr Addict Rep*. 2022;9:217–234. doi:10.1007/s40429-022-00413-y. [PubMed: 35573056]

50. de Dios MA, Vaughan EL, Stanton CA, Niaura R. Adolescent tobacco use and substance abuse treatment outcomes. *J Subst Abuse Treat.* 2009;37(1):17–24. doi:10.1016/j.jsat.2008.09.006. [PubMed: 19004603]
51. Ren M, Lotfipour S. Nicotine gateway effects on adolescent substance use. *West J Emerg Med.* 2019;20(5):696–709. doi:10.5811/westjem.2019.7.41661. [PubMed: 31539325]
52. Patrick ME, Schulenberg JE, Miech RA, Johnston LD, O'Malley PM, Bachman JG. (2022). Monitoring the Future Panel Study annual report: National data on substance use among adults ages 19 to 60, 1976–2021. Monitoring the Future Monograph Series. University of Michigan Institute for Social Research: Ann Arbor, MI. doi:10.7826/ISR-UM.06.585140.002.07.0001.2022.
53. Friese B, Grube JW. Legalization of medical marijuana and marijuana use among youths. *Drugs (Abingdon Engl).* 2013;20(1):33–39. doi:10.3109/09687637.2012.713408. [PubMed: 23641127]
54. Wang JB, Ramo DE, Lisha NE, Cataldo JK. Medical marijuana legalization and cigarette and marijuana co-use in adolescents and adults. *Drug Alcohol Depend.* 2016;166:32–8. doi:10.1016/j.drugalcdep.2016.06.016. [PubMed: 27460859]
55. Lipperman-Kreda S, Grube JW. Impacts of marijuana commercialization on adolescents' marijuana beliefs, use, and co-use with other substances. *J Adolesc Health.* 2018;63(1):5–6. doi:10.1016/j.jadohealth.2018.05.003. [PubMed: 30060857]
56. Opp SM, Mosier SL. Liquor, marijuana, and guns: essential services or political tools during the Covid-19 pandemic. *Policy Design and Practice.* 2020;3:297–311. doi:10.1080.25741292.2020.1810397.
57. Angell T Coronavirus crisis shows marijuana is 'essential' and mainstream. *Forbes, Policy.* March 23, 2020. Available at: <https://www.forbes.com/sites/tomangell/2020/03/23/coronavirus-crisis-shows-marijuana-is-essential-and-mainstream/?sh=44dbd3144db2>. Accessed 24 October 2022.
58. National Conference of State Legislatures. State medical cannabis laws. Available at: <https://www.ncsl.org/research/health/state-medical-marijuana-laws.aspx> Accessed 24 October 2022.
59. American Academy of Pediatrics Policy Statement. The Impact of marijuana policies on youth: clinical, research, and legal update. *Pediatrics.* 2015;135:584–587. doi:10.1542/peds.2014-4146. [PubMed: 25624383]
60. Kong G, Bold KW, Simon P, et al. Reasons for cigarillo initiation and cigarillo manipulation methods among adolescents. *Tob Regul Sci.* 2017;2:S48–S58.
61. Sterling KL, Fryer CS, Nix M, Fagan P. Appeal and impact of characterizing flavors on young adult small cigar use. *Tob Regul Sci.* 2015;1:42–53. [PubMed: 27917396]
62. Majmundar A, Kirkpatrick M, Cruz TB. Characterising KandyPens-related posts to Instagram: implications for nicotine and cannabis use. *Tob Control.* 2020;29(4). doi:10.1136/tobaccocontrol-2019-055006.
63. Roditis ML, Halpern-Felsher B. Adolescents' perceptions of risks and benefits of conventional cigarettes, e-cigarettes, and marijuana: a qualitative analysis. *J Adolesc Health.* 2015;57(2):179–85. doi:10.1016/j.jadohealth.2015.04.002. [PubMed: 26115908]
64. Roditis ML, Delucchi K, Chang A, Halpern-Felsher B. Perceptions of social norms and exposure to pro-marijuana messages are associated with adolescent marijuana use. *Prev Med.* 2016;93:171–176. doi:10.1016/j.ypmed.2016.10.013. [PubMed: 27746339]
65. Cornacchione J, Wagoner KG, Wiseman KD, Kelley D, Noar SM, Smith MH, Sutfin EL. Adolescent and young adult perceptions of hookah and little cigars/cigarillos: implications for risk messages. *J Health Commun.* 2016;21(7):818–25. doi:10.1080/10810730.2016.1177141. [PubMed: 27337629]
66. Antognoli E, Koopman Gonzalez S, Trapl E, et al. The social context of adolescent co-use of cigarillos and marijuana blunts. *Subst Use Misuse.* 2017;53(4):654–661. doi:10.1080/10826084.2017.1355388. [PubMed: 28933976]
67. Antognoli E, Koopman Gonzalez S, Trapl E, et al. Cigarettes, little cigars, and cigarillos: initiation, motivation, and decision-making. *Nicotine Tob Res.* 2018;20(suppl\_1):S5–S11. doi:10.1093/ntr/nty099. [PubMed: 30125020]

68. Morean ME, Davis DR, Kong G, et al. Demographic and substance use-related differences among high school adolescents who vape cannabis versus use other cannabis modalities. *Drug Alcohol Depend.* 2021;228:109104. doi:10.1016/j.drugalcdep.2021.109104. [PubMed: 34607191]
69. Noar SM, Kelley DE, Boynton MH, et al. Identifying principles for effective messages about chemicals in e-cigarette smoke. *Prev Med.* 2018;106:31–37. [PubMed: 28890353]
70. Gaiha SM, Lempert LK, McKelvey K, Halpern-Felsher B. E-cigarette devices, brands, and flavors attract youth: Informing FDA's policies and priorities to close critical gaps. *Addict Behav.* 2021;126:107179. [PubMed: 34861522]
71. Schleicher NC, Johnson TO, Fortmann SP, Heriksen L. Tobacco outlet density near home and school: association with smoking and norm among US teens. *Prev Med.* 2016;91:287–293. [PubMed: 27569829]
72. Miller CA, Guidry JPD, Dahman B, Thomson MD. A tale of two diverse Qualtrics samples: information for online survey researchers. *Cancer Epidemiol Biomarkers Prev.* 2020;29(4):731–735. [PubMed: 32066616]

**Table 1.**

Characteristics of the Study Population by Current (Past 30-Day) Cannabis Use Status

	<i>All Respondents</i> ( <i>N</i> = 2253)	<i>No Cannabis Used in Past 30 days</i> ( <i>n</i> = 874)	<i>Used Cannabis in Past 30 days</i> ( <i>n</i> = 1379)	<i>Adj. p - Value</i> <sup>1</sup>
<b>DEMOGRAPHIC CHARACTERISTICS</b>				
<b><i>Age group category</i></b>				<.001
Adolescents (age 14–17 years)	27.5%	31.9%	24.7%	
Emerging adults (age 18–20 years)	72.5%	68.1%	75.3%	
<b><i>Age &amp; School enrollment</i></b>				0.02
Age 14–17, enrolled in school	26.6%	30.6%	24.0%	
Age 18 or older and enrolled in high school	16.1%	15.1%	16.7%	
Age 18 or older and enrolled in college, training program, or active-duty military	36.3%	34.9%	37.1%	
Any respondent not enrolled school, college, or military	21.1%	19.4%	22.2%	
<b><i>Gender</i></b>				0.63
Female	65.1%	66.3%	64.4%	
Male	31.5%	30.9%	31.9%	
Non-binary or refused	3.4%	2.9%	3.7%	
<b><i>Race/Ethnicity</i></b>				0.04
White (non-Hispanic)	56.9%	56.8%	56.9%	
Hispanic or Latinx	18.8%	20.7%	17.6%	
Black or African American (non-Hispanic)	8.9%	7.8%	9.6%	
Asian or Pacific Islander (non-Hispanic)	5.3%	6.2%	4.8%	
Bi-racial or Multi-racial (non-Hispanic)	4.8%	3.2%	5.7%	
Some other race <sup>2</sup> (non-Hispanic)	5.3%	5.4%	5.3%	
<b><i>Personal income</i></b>				0.17
Live comfortably	42.6%	44.6%	41.3%	
Meet needs with a little left over	29.5%	30.3%	28.9%	
Just meet basic expenses	20.6%	18.9%	21.6%	
Do not meet basic expenses	7.4%	6.2%	8.2%	
<b>SUBSTANCE USE BEHAVIORS</b>				
<b><i>Used any cannabis product ever</i></b>				
No	14.6%	37.5%	0.0%	
Yes	85.4%	62.5%	100.0%	
<b><i>Used cannabis more than 100 times ever</i></b>				<.001
No	59.3%	84.9%	43.0%	
Yes	40.8%	15.1%	57.0%	
<b><i>Used any cannabis product in past 30 days</i></b>				
No	38.8%	100.0%	0.0%	

	<i>All Respondents</i>	<i>No Cannabis Used in Past 30 days</i>	<i>Used Cannabis in Past 30 days</i>	<i>Adj. p - Value<sup>1</sup></i>
	<i>(N = 2253)</i>	<i>(n = 874)</i>	<i>(n = 1379)</i>	
Yes	61.2%	0.0%	100.0%	
<i>Used e-cigarettes more than 100 times ever</i>				<.001
No	48.3%	57.9%	42.1%	
Yes	51.7%	42.1%	57.9%	
<i>Used e-cigarettes in past 30 days</i>				<.001
No	26.8%	45.5%	14.9%	
Yes	73.2%	54.5%	85.1%	
<i>Used smokeless tobacco in past 30 days</i>				<.001
No	84.4%	90.9%	80.4%	
Yes	15.6%	9.2%	19.7%	
<i>Used combustible cigarettes in past 30 days</i>				<.001
No	74.1%	85.1%	67.1%	
Yes	25.9%	14.9%	32.9%	
<i>Used cigars, cigarillos, or small cigars<sup>3</sup> in past 30 days</i>				<.001
No	84.0%	93.8%	77.8%	
Yes	16.0%	6.2%	22.2%	
<i>Used hookah, shisha, or tobacco water pipe in past 30 days</i>				<.001
No	87.4%	96.3%	81.8%	
Yes	12.6%	3.7%	18.2%	
<i>Used alcohol (like beer, wine, or liquor) in past 30 days</i>				<.001
No	39.0%	60.4%	25.5%	
Yes	61.0%	39.6%	74.6%	

<sup>1</sup>The Benjamini-Hochberg Procedure was used to control the false discovery rate via multiple comparisons, adjusted p-values are presented here

<sup>2</sup>Some other race included Native American, Native Hawaiian, or Pacific Islander; Middle Eastern, or "Other"

<sup>3</sup>Cigar use category was 'tobacco only (excludes blunts)'



**Table 2.**

Past 30-Day Substance Use Behaviors by Product Type

	Past 30-day Substance Use <sup>1</sup>							
	Full sample (N = 2253)	Cannabis (n = 1379)	E-cigarettes (n = 1649)	Smokeless tobacco (n = 351)	Cigarettes (n = 584)	Cigars (n = 360)	Hookah/Water pipe (n = 283)	Alcohol (n = 1374)
<b>CANNABIS USE BEHAVIORS</b>								
Cannabis use of any kind	61.2%	100.0%	71.1%	77.2%	77.7%	85.0%	88.7%	74.8%
Cannabis smoked as a joint, spliff, or in a small pipe	46.1%	75.3%	54.8%	62.7%	65.8%	74.7%	77.7%	58.7%
Cannabis smoked as a blunt (marijuana filled cigar)	38.2%	62.4%	46.3%	58.1%	56.5%	73.3%	75.6%	48.4%
Cannabis smoked from a bong, water pipe, or “smoke”	39.9%	65.2%	48.2%	58.1%	62.2%	71.7%	74.6%	51.4%
Cannabis flower, bud, or leaf from a dry leaf vaporizer	22.5%	36.7%	27.6%	47.6%	36.1%	49.4%	58.0%	29.8%
Cannabis oil, wax, or liquid to vape or dab	43.1%	70.4%	51.1%	59.0%	57.5%	69.4%	71.4%	54.9%
Cannabis in an edible cookie, candy, food, or drink	34.7%	56.8%	41.4%	54.4%	49.1%	58.6%	67.8%	45.6%
<b>TOBACCO AND ALCOHOL USE BEHAVIORS</b>								
E-cigarettes or vapes	73.2%	85.1%	100.0%	95.4%	87.8%	91.1%	94.7%	85.7%
Smokeless tobacco products (chew, dip, snus, etc.)	15.6%	19.7%	20.3%	100.0%	33.2%	43.3%	47.7%	19.6%
Cigarettes	25.9%	32.9%	31.1%	55.3%	100.0%	67.5%	53.4%	32.5%
Cigars, cigarillos, or small cigars <sup>2</sup>	15.9%	22.2%	19.9%	44.4%	41.6%	100.0%	49.5%	20.3%
Hookah, shisha, or tobacco water pipe	12.6%	18.2%	16.3%	38.5%	25.9%	38.9%	100.0%	16.1%
Alcohol (like beer, wine, or liquor)	60.9%	74.5%	71.4%	76.6%	76.4%	77.5%	78.1%	100.0%

<sup>1</sup> Non-mutually exclusive denominator categories

<sup>2</sup> Cigar use category was ‘tobacco only (excludes blunts)’

**Table 3.**

## Current Use of Flavored Products Among Cannabis Users

	N	Any flavored product	No flavored product	I don't know
<b><i>FLAVORED CANNABIS PRODUCT USE</i></b>				
Any use of flavored cannabis products				
All past 30-day cannabis users, edibles included	1379	79.6%		
Past 30-day cannabis users, edibles excluded	1339	64.7%		
Flavored cannabis flower, bud, or leaf				
All past 30-day cannabis users	1379	24.4%	64.7%	10.9%
Dry leaf <sup>2</sup> cannabis users only	1222	27.6%	60.2%	12.3%
Flavored wrapping paper used for joints or spliffs (excluding blunts)				
All past 30-day cannabis users	1379	19.7%	73.0%	7.3%
Joint and spliff users only	1038	26.1%	64.2%	9.7%
Flavored cannabis blunt use				
All past 30-day cannabis users	1379	35.8%	56.5%	7.7%
Blunt users only	860	57.4%	30.2%	12.3%
Flavored cannabis oil, wax, or liquid to vape or dab				
All past 30-day cannabis users	1379	36.0%	58.5%	5.5%
Vaped or dabbed cannabis users only	970	51.1%	41.0%	7.8%
<b><i>Use of flavors in tobacco products among cannabis users<sup>1</sup></i></b>				
Flavored e-cigarettes or vapes	1171	91.9%	5.2%	2.9%
Flavored moist snuff, chewing tobacco, or snus	142	76.8%	14.8%	8.5%
Flavored cigarettes (menthol)	454	60.4%	36.1%	3.5%
Flavored cigars, cigarillos, or small cigars (excluding blunts)	306	73.9%	16.3%	9.8%
Flavored hookah, shisha, or tobacco water pipe	250	77.6%	7.6%	14.8%

<sup>1</sup> Flavored product use shown for each tobacco product among past 30-day dual-users of cannabis and that specific tobacco product

<sup>2</sup> Dry leaf users include those reporting past 30-day use of joint, spliff, pipe, blunt, waterpipe, or dry leaf vaporizer

**Table 4.** Multinomial Logistic Regression Estimating Relative Risk Ratios of Current Cannabis Blunt Use Frequency<sup>1</sup>

	<i>Cannabis Blunt Use in Past 30 Days</i>	<i>No blunt use ever</i> RRR (95% CI)	<i>No blunt use in past 30 days</i>	<i>Used blunts 1–5 days</i> RRR (95% CI)	<i>Used blunts 6–19 days</i> RRR (95% CI)	<i>Used blunts 20 or more days</i> RRR (95% CI)
<b>Age &amp; School Enrollment</b>						
Age 14–17, enrolled in school	reference	reference	reference	reference	reference	reference
Age 18–20, enrolled in high school	0.85 [0.60–1.20]	reference	reference	0.77 [0.49–1.19]	1.41 [0.82–2.44]	0.91 [0.55–1.51]
Age 18–20, enrolled in college, training program, or military	0.61 [0.46–0.80]***	reference	reference	0.73 [0.52–1.02]*	0.66 [0.41–1.06]	0.55 [0.36–0.84]*
Any respondent not enrolled in school, college, or military	0.57 [0.41–0.80]**	reference	reference	0.79 [0.53–1.19]	1.36 [0.81–2.27]	1.21 [0.77–1.81]
<b>Gender</b>						
Female	reference	reference	reference	reference	reference	reference
Male	0.92 [0.72–1.18]	reference	reference	1.15 [0.86–1.53]	1.03 [0.70–1.50]	1.14 [0.81–1.59]
Non-binary or refused	0.99 [0.55–1.76]	reference	reference	0.86 [0.40–1.84]	0.70 [0.24–1.98]	0.62 [0.24–1.60]
<b>Race/Ethnicity</b>						
Non-Hispanic White	reference	reference	reference	reference	reference	reference
Hispanic or Latinx	1.50 [1.12–2.02]*	reference	reference	1.52 [1.05–2.20]	2.08 [1.32–3.30]**	1.88 [1.22–2.89]*
Black or African American (non-Hispanic)	1.27 [0.83–1.94]	reference	reference	1.78 [1.07–2.98]	2.60 [1.40–4.81]**	3.47 [2.04–5.92]***
Asian or Pacific Islander (non-Hispanic)	1.87 [1.17–3.00]*	reference	reference	0.91 [0.46–1.78]	1.06 [0.41–2.73]	1.85 [0.90–3.80]
Bi-racial or Multiracial (non-Hispanic)	1.07 [0.59–1.95]	reference	reference	2.53 [1.38–4.65]**	3.20 [1.51–6.81]**	3.54 [1.79–6.99]***
Some other race <sup>2</sup> (non-Hispanic)	1.27 [0.76–2.11]	reference	reference	1.05 [0.55–2.00]	1.79 [0.87–3.68]	1.41 [0.70–2.84]
<b>Personal income</b>						
“Live comfortably”	reference	reference	reference	reference	reference	reference
“Meet needs with a little left over”	0.97 [0.75–1.25]	reference	reference	0.84 [0.62–1.15]	1.06 [0.69–1.62]	1.14 [0.78–1.68]
“Just meet basic expenses”	1.28 [0.94–1.73]	reference	reference	1.18 [0.82–1.71]	1.93 [1.23–3.06]*	2.36 [1.56–3.58]***
“Do not meet basic expenses”	1.04 [0.63–1.69]	reference	reference	1.40 [0.80–2.43]	2.25 [1.18–4.30]*	3.70 [2.11–6.47]***

<i>Cannabis Blunt Use in Past 30 Days</i>	<i>No blunt use ever RRR (95% CI)</i>	<i>No blunt use in past 30 days</i>	<i>Used blunts 1–5 days RRR (95% CI)</i>	<i>Used blunts 6–19 days RRR (95% CI)</i>	<i>Used blunts 20 or more days RRR (95% CI)</i>
<b>Recent Substance Use Behaviors</b>					
None in past 30-days	reference	reference	reference	reference	reference
Used e-cigarettes in past 30 days	0.66 [0.51–0.85]**	reference	2.44 [1.67–3.58]***	2.17 [1.29–3.64]**	2.56 [1.61–4.05]***
Used smokeless tobacco in past 30 days	1.51 [1.04–2.20]	reference	1.23 [0.82–1.83]	1.14 [0.69–1.86]	0.99 [0.62–1.56]
Used combustible cigarettes in past 30 days	1.05 [0.77–1.41]	reference	1.28 [0.93–1.78]	1.40 [0.93–2.11]	1.29 [0.89–1.87]
Used cigars, cigarillos, or small cigars in past 30 days <sup>3</sup>	1.07 [0.68–1.68]	reference	2.91 [1.90–4.45]***	2.54 [1.52–4.25]***	4.55 [2.88–7.17]***
Used hookah, shisha, or tobacco water pipe in past 30 days	1.40 [0.83–2.34]	reference	3.00 [1.84–4.89]***	5.60 [3.28–9.57]***	4.04 [2.41–6.77]***
Used alcohol (like beer, wine, or liquor) in past 30 days	0.64 [0.51–0.81]***	reference	1.64 [1.21–2.22]**	2.52 [1.65–3.86]***	2.13 [1.48–3.06]***

<sup>1</sup>N = 2252

<sup>2</sup>Race/ethnicity included Hispanic or Latinx, Non-Hispanic Black or African American, and Some other race. “Some other race” included Native American, Native Hawaiian, or Pacific Islander; Middle Eastern, or “Other Non-White”

<sup>3</sup>Cigar use category was ‘tobacco only (excludes blunts)’

<sup>4</sup>The Benjamini-Hochberg Procedure was used to control the false discovery rate via multiple comparisons; adjusted p-values are presented here:

\* = p<.05

\*\* = p<.01

\*\*\* = p<.001

Abbreviations: CI = confidence interval; RRR = relative risk ratio

Table 5.

Multinomial Logistic Regression Estimating Relative Risk Ratios of Current Liquid Cannabis Vape (LCV) Use Frequency<sup>1</sup>

	<i>Liquid Cannabis Vape (LCV) Use in Past 30 Days</i>	<i>No LCV use ever</i> RRR (95% CI)	<i>No LCV use in past 30 days</i>	<i>Used LCV 1–5 days</i> RRR (95% CI)	<i>Used LCV 6–19 days</i> RRR (95% CI)	<i>Used LCV 20 or more days</i> RRR (95% CI)
<b>Age &amp; School Enrollment</b>						
Age 14–17, enrolled in school	reference	reference	reference	reference	reference	reference
Age 18–20, enrolled in high school	0.92 [0.64–1.33]	reference	reference	0.86 [0.55–1.33]	1.15 [0.67–1.96]	1.15 [0.73–1.80]
Age 18–20, enrolled in college, training program, or military	0.79 [0.59–1.06]	reference	reference	0.64 [0.45–0.90] <sup>*</sup>	0.61 [0.39–0.95]	0.61 [0.42–0.88] <sup>*</sup>
Any respondent not enrolled in school, college, or military	0.73 [0.52–1.03]	reference	reference	0.53 [0.34–0.80] <sup>**</sup>	1.05 [0.65–1.71]	0.91 [0.60–1.38]
<b>Gender</b>						
Female	reference	reference	reference	reference	reference	reference
Male	0.94 [0.73–1.21]	reference	reference	0.92 [0.68;1.25]	0.96 [0.66;1.39]	1.33 [0.98;1.80]
Non-binary or refused	1.08 [0.57–2.06]	reference	reference	0.94 [0.14;2.12]	2.10 [0.91;4.83]	1.22 [0.54;2.78]
<b>Race/Ethnicity</b>						
Non-Hispanic White	reference	reference	reference	reference	reference	reference
Hispanic or Latinx	1.46 [1.03–1.91]	reference	reference	1.16 [0.80–1.70]	1.01 [0.64–1.60]	1.16 [0.78–1.72]
Black or African American (non-Hispanic)	1.44 [0.95–2.18]	reference	reference	1.16 [0.69–1.93]	0.69 [0.35–1.35]	0.93 [0.54–1.61]
Asian or Pacific Islander (non-Hispanic)	1.29 [0.80–2.09]	reference	reference	0.87 [0.47–1.64]	0.83 [0.37–1.84]	0.80 [0.40–1.59]
Bi-racial or Multiracial (non-Hispanic)	1.46 [0.79–2.67]	reference	reference	1.74 [0.88–3.44]	2.33 [1.12–4.86]	2.10 [1.07–4.12]
Some other race <sup>2</sup> (non-Hispanic)	1.88 [1.08–3.25]	reference	reference	1.55 [0.81–2.98]	0.52 [0.20–1.39]	1.27 [0.64–2.50]
<b>Personal income</b>						
“Live comfortably”	reference	reference	reference	reference	reference	reference
“Meet needs with a little left over”	0.96 [0.73–1.25]	reference	reference	1.03 [0.75–1.42]	1.12 [0.74–1.68]	0.97 [0.69–1.36]
“Just meet basic expenses”	1.13 [0.83–1.55]	reference	reference	1.10 [0.75–1.61]	2.08 [1.35–3.21] <sup>**</sup>	1.45 [0.99–2.13]
“Do not meet basic expenses”	0.96 [0.58–1.59]	reference	reference	1.49 [0.85–2.60]	1.61 [0.82–3.15]	2.08 [1.21–3.58] <sup>*</sup>
<b>Recent Substance Use Behaviors</b>						

<i>Liquid Cannabis Vape (LCV) Use in Past 30 Days</i>	<i>No LCV use ever RRR (95% CI)</i>	<i>No LCV use in past 30 days reference</i>	<i>Used LCV 1-5 days RRR (95% CI)</i>	<i>Used LCV 6-19 days RRR (95% CI)</i>	<i>Used LCV 20 or more days RRR (95% CI)</i>
None in past 30-days	<i>reference</i>	<i>reference</i>	<i>reference</i>	<i>reference</i>	<i>reference</i>
Used e-cigarettes in past 30 days	0.58 [0.45-0.76]***	<i>reference</i>	1.68 [1.15-2.44]*	1.59 [0.99-2.56]	1.76 [1.19-2.59]**
Used smokeless tobacco in past 30 days	1.73 [1.16-2.59]*	<i>reference</i>	1.56 [1.02-2.38]	1.45 [0.88-2.38]	1.00 [0.64-1.58]
Used combustible cigarettes in past 30 days	1.00 [0.73-1.37]	<i>reference</i>	1.10 [0.78-1.55]	1.03 [0.69-1.56]	1.24 [0.88-1.76]
Used cigars, cigarillos, or small cigars in past 30 days <sup>3</sup>	0.75 [0.48-1.17]	<i>reference</i>	1.60 [1.03-2.48]	2.40 [1.48-3.91]****	1.90 [1.22-2.93]**
Used hookah, shisha, or tobacco water pipe in past 30 days	1.82 [1.08-3.06]	<i>reference</i>	3.22 [1.92-5.40]****	3.87 [2.19-6.84]****	3.27 [1.93-5.54]****
Used alcohol (like beer, wine, or liquor) in past 30 days	0.84 [0.65-1.07]	<i>reference</i>	2.58 [1.88-3.54]****	2.66 [1.80-3.94]****	2.46 [1.78-3.40]****

<sup>1</sup>N = 2252

<sup>2</sup>Race/ethnicity included Hispanic or Latinx, Non-Hispanic Black or African American, and Some other race. “Some other race” included Native American, Native Hawaiian, or Pacific Islander; Middle Eastern, or “Other Non-White”

<sup>3</sup>Cigar use category was ‘tobacco only (excludes blunts)’

<sup>4</sup>The Benjamini-Hochberg Procedure was used to control the false discovery rate via multiple comparisons; adjusted p-values are presented here:

\* = p<.05

\*\* = p<.01

\*\*\* = p<.001

Abbreviations: CI = confidence interval; RRR = relative risk ratio