



Nicotine and cannabis routes of administration and dual use among U.S. young adults who identify as Hispanic, non-Hispanic Black, and non-Hispanic White

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ABSTRACT

Background: Use of cannabis and nicotine is at record levels among young adults, and health consequences vary by route of administration. However, there is a paucity of research characterizing use of both substances, especially among individuals of racial/ethnic minoritized identities.

Method: Participants (N = 1,032; age 18–25 years) completed a cross-sectional survey administered through an online panel in 2021 in eight U.S. states where cannabis was legal for both recreational and medical use and eight states where cannabis was not legal for medical or recreational purposes. Sampling was stratified by race/ethnicity (Hispanic, non-Hispanic Black, non-Hispanic White) and gender (male, female). Survey weighting was based on state-level gender and race/ethnicity data in the 2021 U.S. Census Bureau.

Results: Over one third (37.9%) of respondents reported current use of both cannabis and tobacco, more than double the proportion using tobacco (12.1%) or cannabis (4.1%) only. Vaporization was the most common method for using nicotine (40.2%). Disposable nicotine vape products were used more than any other method (27.1%). Smoking was the most common route of administration for cannabis (35.7%). Simultaneous use of tobacco and cannabis was common (27.0%) overall and greater among those who identify as non-Hispanic Black than non-Hispanic White. There were few differences in product use by gender or state legality.

Discussion: Dual cannabis and tobacco use is prevalent among young adults. Given the dynamic regulatory landscape, continued monitoring of specific cannabis formulations and tobacco products is recommended. Trends in simultaneous use of cannabis and tobacco and associated adverse effects warrant continued assessment.

1. Introduction

Cannabis use among U.S. young adults has reached historic prevalence, with 43.6 % of individuals reporting use annually (Patrick et al., 2023). Peak cannabis use typically occurs between ages 18–25, (Schauer et al., 2015) and the sharpest lifetime increase in cannabis use often occurs in the transition to young adulthood, (Tucker et al., 2019) highlighting an elevated risk of economic and health consequences among this age group. The number of young adults using nicotine via vaporization is also elevated; the increase in vaping among those 19–22

years of age in 2021 represented the largest increase of any substance in the 45-year history of the Monitoring the Future survey (Schulenberg et al., 2020). The use of both cannabis and nicotine, or dual use, among young adults ranges from 23 %–48 % (Cohn et al., 2019; Tucker et al., 2019; Cohn and Chen, 2022). Dual use is concerning given adverse effects including higher rates of cannabis use disorder, (National Academies of Sciences, Engineering, and Medicine, 2017) difficulty quitting use of either substance, (Haney et al., 2013; Montgomery, 2015; Peters et al., 2012; Ford et al., 2002; Gourlay et al., 1994; McClure et al., 2020; Schauer et al., 2017; Vogel et al., 2018) and additive health risks (Bliss,

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1935; Meier and Hatsukami, 2016).

Innovations in cannabis delivery methods have created a diverse array of formulation use, (Stith et al., 2023) and subjective effects and risk profiles (i.e., health consequences) vary by cannabis formulations (Bidwell et al., 2021; Freeman and Winstock, 2015; Simpson et al., 2021; Stuyt, 2018) and routes of administration, including simultaneous use with nicotine (Tucker et al., 2019; Chu et al., 2023). Cannabis formulation prevalence among U.S. adults shows that smoking flower is the most common, followed by edible, vaporized, and dabbed; (Schauer et al., 2020; Schauer et al., 2016) obtaining estimates specific for young adults is important to inform prevention and treatment efforts among this high priority group. Furthermore, given that cannabis use rates and patterns vary based on legality, (Goodman et al., 2020; Steigerwald et al., 2020; Krauss et al., 2017; Hasin et al., 2023) it is critical that investigations of young adult cannabis use take state legality into account (Chiu et al., 2021; Lachance et al., 2022).

The risk profile for nicotine product use also varies based on administration method, (Pulvers et al., 2020; Hartmann-Boyce et al., 2023; Nutt et al., 2014) making it important to distinguish combustible and non-combustible products. Vaping nicotine has steadily increased among young adults, with an annual rate of 23.7 % in 2022, while cigarette use has declined to 17.8 % in 2022 (Patrick et al., 2023). Early evidence suggested differences in abuse liability based on product features, (Tackett et al., 2021; Foulds et al., 2015; Etter, 2015) but as vape devices have evolved, it has become clearer that dependence levels are driven by factors such as nicotine delivery which is not necessarily specific to product design (Douglas et al., 2022; Do et al., 2022; Douglas et al., 2023). Nonetheless, documenting use rates of specific nicotine vape products (e.g., disposable vs. mod/tank) is important for surveillance to inform regulatory efforts.

Investigating nicotine and cannabis administration routes for members of minoritized groups in the U.S. is particularly important given racial/ethnic disparities in cannabis and nicotine use health consequences (Zhu and Wu, 2016; McElrath et al., 2016; Haiman et al., 2006; Wu et al., 2014; Wu et al., 2016; Cunningham, 1999–2015.). Studies that do not assess administration methods may mask important racial/ethnic differences in substance use that can impact outcomes. For example, while cannabis use prevalence may not vary by racial/ethnic group in the U.S., (Steigerwald et al., 2018) several studies have found that more harmful methods, such as blunt use (Fairman, 2015; Hasin et al., 2015; Cooper and Haney, 2009) are most common among African American individuals (Mantey et al., 2021; Mantey et al., 2024).

Therefore, the goal of this research was to describe the use of tobacco and cannabis administration methods among a sample of female and male young adults from the three largest racial/ethnic groups in the U.S. in states where cannabis is legal and illegal. Understanding dual use is important given greater health consequences associated with use of both products (Bliss, 1935; Ford et al., 2002; Gourlay et al., 1994; Haney et al., 2013; McClure et al., 2020; Meier and Hatsukami, 2016; Montgomery, 2015; National Academies of Sciences, Engineering, and Medicine, 2017; Peters et al., 2012; Schauer et al., 2017; Vogel et al., 2018) and the positive feedback loop between tobacco and cannabis formulation use (Nguyen et al., 2023). This information will inform prevention and treatment of nicotine and cannabis use among the high-risk young adult group.

2. Methods

2.1. Participants

Participants completed a cross-sectional survey through an online panel survey service, Qualtrics, from February-May 2021. Qualtrics partners with over 20 online sample providers with access to actively managed, double-opt-in market research panels. Respondents were invited to surveys in various ways, including email invitation, in-app notification, or SMS notification. Respondents could also see surveys

for which they were likely to qualify when signing into a panel portal. Prospective participants were informed that the survey is for research purposes only, how long the survey was expected to take, and what incentives were available. To avoid self-selection bias, survey invitations did not include specific details about the contents of the survey.

Participants eligible for this study self-identified as being between the ages of 18 and 25. The sample was stratified to obtain equal samples of each of the three largest racial/ethnic groups in the U.S. and each of the two largest gender identity groups, and included eight states where cannabis was legal for both recreational and medical use and eight states where cannabis was illegal for both recreational or medical use for at least four years preceding data collection. Legal states included Alaska, Colorado, District of Columbia, Maine, Massachusetts, Nevada, Oregon, and Washington. Illegal states included Alabama, Idaho, Kansas, Nebraska, North Carolina, South Carolina, Tennessee, and Wyoming.

Overall, 2,010 participants began the screener for this study, 732 did not meet the study criteria and were ineligible, 182 viewed the consent form and did not proceed to the survey, and 57 did not finish the survey or exceeded speed limits (completed in less than half the median time). Qualtrics completed a quality check that assured no duplicate responses. Seven participants completed the survey and were later identified as not eligible because they identified as multiple eligible racial/ethnic groups and could not accurately be classified into a single group; they were removed from the dataset *post-hoc*. The final study sample consisted of 1,032 participants. Reasons for ineligibility including residing outside an eligible state (N = 360); outside the required age range (N = 274), identifying as a gender other than a-priori stratification specifier self-identified male or female (N = 55), and identifying as a race/ethnicity other than other than a-priori stratification specifier Hispanic/Latinx, non-Hispanic white, or non-Hispanic black (N = 43). The a-priori stratification specifiers were a methodological strategy to gain a sufficient number of participants to obtain precise estimates of product use for each subgroup.

2.2. Procedure

All procedures were approved by the California State University San Marcos Institutional Review Board. Qualtrics used existing participant information about age and U.S. residence to direct prospective participants to the study. Potential participants directed to the study were presented with the informed consent page. Once they provided consent, they were asked screening questions to determine eligibility. Eligible participants who consented were presented with the survey questions. If participants did not consent, they were forwarded to the end-of-survey message with free and confidential resources for emotional support and smoking and vaping cessation. The survey took approximately 20 min to complete.

Qualtrics provided incentives to panelists based on the length of the survey, their specific panelist profile, and target acquisition difficulty. The specific rewards varied and may have included cash, airline miles, gift cards, redeemable points, charitable donations, sweepstakes entrance, and vouchers. Our consent form stated that participants would be compensated the amount they agreed upon before entering the survey; this amount was determined directly by Qualtrics and not reported to the researchers.

2.3. Measures

Participant characteristics included gender (female or male), (Holzberg et al., 2018) race/ethnicity (non-Hispanic Black or African American, Hispanic/Latinx, or non-Hispanic White), (Office of Management and Budget, 1997) and gross annual household income (Semega and Kollar, 2022).

2.3.1. Tobacco use

Ever and past 30 day-use of the following products were assessed and

included visual illustrations to aid participants in recall: cigarettes, hand-rolled cigarettes, little cigar or cigar, bidi, tobacco pipe, cigar, hookah, smokeless tobacco. For each product used within the past 30 days, number of use days and typical quantity (i.e., cigarettes) or frequency (i.e., sessions) on use days were assessed. Quantity and frequency units are provided in the tables.

2.3.2. Cannabis use

Ever and past 30-day use of the following routes of administration were assessed and included visual illustrations to aid participants in reporting: smoking (joints, blunts, pipe, bong, flower/bud, kief, spice), vaping, dabbing (torch, rig), edible, and topical. Methods of simultaneous cannabis and tobacco use included blunt (cannabis in hollowed cigar), spliff (cannabis and tobacco combined in rolling paper or cannabis added to tobacco cigarette), mole (cannabis and tobacco combined in a bowl, also known as *moke* or *chops*), and hookah (cannabis and tobacco combined in a hookah).

For each product group used within the past 30 days, number of use days and typical quantity (i.e., joints) or frequency (i.e., sessions) on use days were assessed. Quantity and frequency units are provided in the tables. Cannabis was referred to as “marijuana” in the survey to be consistent with language in national surveys at the time (Schulenberg et al., 2021; Substance Abuse and Mental Health Services Administration, 2021).

Dual use was defined as use of any tobacco and any cannabis, including simultaneous tobacco and cannabis use.

2.4. Analytic approach

To obtain population estimates to use for weighting our survey sample, we gathered state-level demographic data from the U.S. Census Bureau’s American Community Survey (ACS) one-year estimates for 2021. The ACS provides annual population estimates on key demographics for states across the U.S. (U.S. Census Bureau, 2021). Our survey included respondents from the 16 states included in our sample. For each state, we extracted ACS data on gender, and race/ethnicity distributions to use as population benchmarks (US Census Bureau, 2021). Specifically, we gathered data on: Gender [male and female], and Race/ethnicity [non-Hispanic White (NHW), non-Hispanic Black (NHB), Hispanic].

State-level ACS census distributions were used to calculate survey weights to align our sample demographics to the overall target population demographics within each state. Lifetime and past 30-day prevalence and mean number of days used/quantity for each product with 95% confidence intervals (CI) were generated for the overall sample and by gender, race/ethnicity, and state legality, accounting for survey stratification and weighting. Differences in population prevalence and means were identified by observation of non-overlapping confidence intervals, i.e., the upper confidence limit of one CI was below the lower confidence limit of the other CI (Kline, 2004). Data were analyzed using SAS Enterprise Guide Version 8.3 (SAS 9.4), SAS Institute Inc., Cary, NC, USA.

3. Results

3.1. Participant characteristics

The unweighted sample was composed of 57.5% female participants and approximately one third who identified as Hispanic (any race; 33.5%), NHW (33.9%), and NHB (32.6%). The mean age of participants was 20.9 (SD = 2.2) years and 52.9% had an annual income of less than \$35,000.

3.2. Tobacco and cannabis single and dual product use

Two thirds of the sample (64.1%; N = 662) reported ever having

used tobacco or cannabis and over half (54.2%; N = 559) reported use of tobacco or cannabis in the past 30 days. The lifetime prevalence of dual use in the sample was 47.9% (95% CI = 44.1, 51.6) and the current rate of dual use in the sample was 37.9% (95% CI = 34.2, 41.5). Lifetime use of only tobacco was 12.9% (95% CI = 10.3, 15.6) and only cannabis was 3.8% (95% CI = 2.4, 5.2). Current use of only tobacco was 12.1% (95% CI = 9.5, 14.7) and only cannabis was 4.1% (95% CI = 2.7, 5.5). These rates did not vary by gender, race/ethnicity, or state legality of cannabis.

Among those who ever used tobacco or cannabis, 74.1% (95% CI = 69.9, 78.3) used both substances, while 20% (95% CI = 16.1, 23.9) used tobacco only and 5.9% (95% CI = 3.8, 8.0) used cannabis only. Past 30-day use of both cannabis and tobacco was also far more common (70.1%; 95% CI = 65.3, 74.8) than use of tobacco alone (22.4%; 95% CI = 17.9, 26.8) or cannabis alone (7.6%; 95% CI = 5.0, 10.2) in the sub-sample.

3.3. Current tobacco product use

As shown in Table 1, past 30-day use of combustible tobacco use was 29.4% (95% CI = 26.0, 32.9). Cigarettes were the most frequently used combustible tobacco product (19.6; 95% CI = 16.5, 22.6). There was no gender difference in rate of past 30-day combustible tobacco product use overall, and few gender differences in current combustible tobacco product use (Table 2). Cigars were the only product used more frequently by males (8.4%; 95% CI = 5.4, 11.4) compared to females (2.5%; 95% CI = 1.0, 4.1). As shown in Table 3, there were no racial/ethnic differences in rate of past 30-day combustible product use overall or for any specific combustible product. However, hookah use was heavier among non-Hispanic Black (6.3 days; 95% CI = 3.0, 9.6) than non-Hispanic White individuals (1.0 days; 95% CI = 0.4, 1.5), and cigarette use was heavier among non-Hispanic White (7.2 cigarettes per day; 95% CI = 5.3, 9.0) than Hispanic (3.7 cigarettes per day; 95% CI = 2.2, 5.2). As shown in Table 4, there were no differences between states where cannabis is legal vs. illegal in rate of past 30-day combustible product use overall or for any specific combustible product.

Past 30-day use of nicotine vape products was reported by 40.2% (95% CI = 36.5, 43.9). As shown in Table 1, current use of disposables (27.1%, 95% CI = 23.7, 30.4) was higher than other methods. There were no gender, racial/ethnic, or state cannabis legality differences in past-30 day use of nicotine vape products overall or by product (Tables 2-4). However, use of rechargeable vapes was more frequent on days in which it was used among NHW (10.4 sessions/day; 95% CI = 7.6, 13.3) than NHB (5.4 sessions/day; 95% CI = 3.4, 7.4) individuals.

3.4. Current cannabis product use

Past 30-day prevalence of smoking cannabis was 35.7% (95% CI = 32.1, 39.3) and simultaneous use of cannabis and tobacco (blunt, spliff, chops, or hookah) was 27.0% (95% CI = 23.7, 30.3). Rates of vaping cannabis (16.1%; 95% CI = 13.3, 18.9) and edible cannabis (15.7%; 13.0, 18.4) were comparable. Current rates of dabbing cannabis (9.9%; 95% CI = 7.6, 12.2) and topical administration (5.5%; 95% CI = 3.9, 7.2) were lower than other methods. Of the four simultaneous cannabis and tobacco administration methods, current use of blunt (16.0%; 95% CI = 13.2, 18.8) and spliff (13.8%; 95% CI = 11.3, 16.3) were the most common.

As shown in Table 2, there were no gender differences in rates of lifetime use of cannabis administration methods. As shown in Table 3, there were racial/ethnic differences in lifetime use of two cannabis administration methods. Dabbing cannabis was more frequent among NHW (11.4%; 95% CI = 8.1, 14.7) than NHB (5.2%; 95% CI = 2.7, 7.6) individuals. Simultaneous use of cannabis and tobacco in a hookah was more frequent among NHB (10.7%; 95% CI = 7.0, 14.4) than NHW (3.9%; 95% CI = 1.9, 5.9) individuals.

Use of four cannabis administration methods was heavier among

Table 1
Weighted frequency (%; 95 % CI) of tobacco and cannabis product lifetime and current use; number of past 30 days used and typical quantity or frequency used (Mean; 95 % CI) in U.S. young adults in 2021.

N = 1,032	Lifetime use ¹	Current use ²	Number days used ³	Quantity or Frequency used per day ^{3,4}
Tobacco Products	% (95 % CI)	% (95 % CI)	Mean (95 % CI)	Mean (95 % CI)
Smokeless tobacco (dips/chews)	11.9 (9.4, 14.4)	4.7 (3.2, 6.3)	4.0 (2.0, 6.0)	4.7 (1.9, 7.5)
Combustible tobacco	42.0 (38.2, 45.7)	29.4 (26.0, 32.9)	N/A	N/A
Cigarettes	31.9 (28.3, 35.4)	19.6 (16.5, 22.6)	9.9 (8.1, 11.7)	6.4 (5.0, 7.8)
Hand-rolled cigarettes	16.5 (13.6, 19.3)	6.9 (5.0, 8.8)	2.9 (1.8, 4.1)	4.7 (2.9, 6.4)
Little cigars or cigarillos	19.7 (16.7, 22.7)	9.8 (7.7, 12.0)	3.6 (2.5, 4.7)	2.8 (2.1, 3.5)
Bidis	5.0 (3.4, 6.6)	2.6 (1.5, 3.6)	4.2 (1.8, 6.6)	3.8 (2.2, 5.3)
Tobacco pipe (bowl)	6.9 (4.9, 8.9)	1.9 (0.9, 2.8)	1.9 (0.2, 3.6)	3.0 (1.8, 4.1)
Cigars	12.6 (10.0, 15.1)	5.6 (3.8, 7.3)	1.9 (1.0, 2.8)	3.2 (0.6, 5.8)
Hookah (sessions)	14.3 (11.7, 16.9)	5.4 (3.8, 7.0)	2.0 (1.3, 2.6)	4.0 (2.1, 6.0)
Vape products (sessions)	52.1 (48.3, 55.9)	40.2 (36.5, 43.9)	N/A	N/A
Disposable vape	36.6 (33.0, 40.3)	27.1 (23.7, 30.4)	9.8 (8.3, 11.2)	8.4 (6.9, 10.0)
Puff Krush add-on	7.3 (5.3, 9.2)	4.2 (2.8, 5.6)	3.9 (2.2, 5.6)	6.9 (2.6, 11.1)
Rechargeable vape	30.6 (27.0, 34.1)	19.3 (16.2, 22.3)	8.1 (6.5, 9.7)	9.0 (7.0, 11.1)
Mod/Tank	29.7 (26.2, 33.2)	16.5 (13.7, 19.3)	7.2 (5.6, 8.9)	9.9 (7.6, 12.3)
Heat-not-burn vape	5.4 (3.7, 7.1)	3.9 (2.5, 5.4)	4.5 (2.8, 6.2)	3.5 (2.3, 4.8)
Cannabis Products				
Smoked marijuana (joints/blunts/bowls)	40.2 (36.6, 43.9)	35.7 (32.1, 39.3)	11.4 (9.9, 12.9)	5.2 (4.2, 6.2)
Simultaneous Marijuana and Tobacco	34.9 (31.4, 38.5)	27.0 (23.7, 30.3)	N/A	N/A
Blunt ⁴	23.0 (19.8, 26.3)	16.0 (13.2, 18.8)	6.2 (4.8, 7.5)	3.4 (2.4, 4.4)
Spliff ⁴	22.2 (19.1, 25.4)	13.8 (11.3, 16.3)	5.9 (4.5, 7.2)	4.5 (3.5, 5.5)
Mole ⁴	15.0 (12.2, 17.8)	8.7 (6.5, 10.9)	5.5 (3.6, 7.5)	3.6 (2.5, 4.6)
Hookah with marijuana ⁴ (sessions)	11.6 (9.3, 13.9)	5.8 (4.2, 7.4)	4.3 (2.6, 6.1)	6.2 (3.8, 8.5)
Vaped marijuana (THC oil; sessions)	26.4 (23.1, 29.8)	16.1 (13.3, 18.9)	6.0 (4.6, 7.5)	4.8 (3.5, 6.1)
Dabbed marijuana (wax, shatter, crumble; sessions)	16.4 (13.5, 19.3)	9.9 (7.6, 12.2)	8.0 (5.7, 10.2)	5.5 (3.4, 7.5)

Table 1 (continued)

N = 1,032	Lifetime use ¹	Current use ²	Number days used ³	Quantity or Frequency used per day ^{3,4}
Tobacco Products	% (95 % CI)	% (95 % CI)	Mean (95 % CI)	Mean (95 % CI)
Edible (servings)	29.6 (26.2, 33.1)	15.7 (13.0, 18.4)	3.0 (2.4, 3.7)	3.1 (2.0, 4.2)
Topical (sessions)	8.6 (6.6, 10.6)	5.5 (3.9, 7.2)	6.0 (3.5, 8.4)	4.6 (1.7, 7.5)

Notes: ¹Ever used, even once; percent reflects weighted proportion of total sample (1,032). ²Use on > 1 day/last 30 days; percent reflects weighted proportion of total sample (1,032). ³For current users. ⁴Cannabis products that also contain tobacco. ⁴Unit is same as the product name (i.e., cigarette) unless indicated in parentheses.

NHB than NHW young adults. Blunts were used on twice as many days among NHB (10.1 days; 95 % CI = 7.2, 13.1) than NHW (5.4 days; 95 % CI = 3.6, 7.1) individuals. Spliffs were also used on twice as many days among NHB (9.9 days; 95 % CI = 7.4, 12.4) than NHW (4.2 days; 95 % CI = 2.3, 6.0) individuals. Vaping was more frequent among NHB (6.4 sessions; 95 % CI = 4.0, 8.8) than NHW (4.4 sessions, 95 % CI = 2.5, 6.2) individuals. Edibles were used on three times as many days among NHB (6.5 days; 95 % CI = 4.3, 8.7) than NHW (2.1 days; 95 % CI = 1.3, 2.9) individuals.

As shown in Table 4, current use of cannabis administration methods was comparable in states where cannabis was legal or illegal, except for dabbing which was more frequent in legal (13.7 %; 95 % CI = 9.9, 17.5) than illegal (6.8 %; 95 % CI = 4.0, 9.6) states. However, blunt use was heavier in states where cannabis was illegal (7.9 days; 95 % CI = 5.7, 10.3) than legal (4.0 days; 95 % CI = 2.9, 5.2), and dabbing frequency was greater in legal (7.4 sessions/day; 95 % CI = 3.9, 10.8) than illegal (2.7 sessions/day; 95 % CI = 1.9, 3.5) states.

4. Discussion

The present investigation meets a call to action to study dual use of cannabis and tobacco (Hindocha and McClure, 2021) and focuses on the high priority young adult population (Schauer et al., 2015; Tucker et al., 2019; Schulenberg et al., 2020; Blair et al., 2022). We found that most of our young adult U.S. sample who used cannabis or nicotine in 2021 displayed dual use. Our finding of a 37.9 % current prevalence of dual cannabis and tobacco use among young adults in 2021 aligns with previous estimates ranging from 23 % to 48 % (Cohn et al., 2019; Tucker et al., 2019; Cohn and Chen, 2022). Furthermore, among those who used cannabis or tobacco in the past 30 days, the majority (70 %) used both as opposed to.

tobacco alone (22 %) or cannabis alone (8 %). Given compounded health risk for those who use both cannabis and tobacco compared to one or the other, (Bliss, 1935; Ford et al., 2002; Gourlay et al., 1994; Haney et al., 2013; McClure et al., 2020; Meier and Hatsukami, 2016; Montgomery, 2015; National Academies of Sciences, Engineering, and Medicine, 2017; Peters et al., 2012; Schauer et al., 2017; Vogel et al., 2018) prevention and treatment approaches inclusive of both are warranted (Adams et al., 2018; Lee et al., 2019; McClure et al., 2020).

Current use of nicotine vape products was reported by over a third of our sample (40 %) and disposables were used more than any other method. This represents a shift from when rechargeable e-cigarettes delivering high potency nicotine like JUUL® were the dominant method (Romberg et al., 2019; Huang et al., 2019; Kavuluru et al., 2019; Williams, 2020). A flavor ban on pre-filled cartridges used in rechargeable e-cigarettes was enacted in early 2020 to address the youth vaping epidemic, which was met with public health concern that a shift to disposable e-cigarettes would occur, due to being outside the ban and available in flavors with equally high potency (Dai and Hao, 2022). Our

Table 2

Weighted frequency (%; 95 % CI) of tobacco and cannabis product lifetime and current use; number of past 30 days used and typical quantity or frequency used (Mean; 95 % CI) in U.S. young adults in 2021, by gender.

	Lifetime use ¹ % (95 % CI)		Current use ² % (95 % CI)		Number days used ³ Mean (95 % CI)		Quantity or Frequency used per day ^{3, 5} Mean (95 % CI)	
	Male N = 439	Female N = 593	Male N = 439	Female N = 593	Male	Female	Male	Female
Tobacco Products								
Smokeless tobacco (dips/chews)	16.8 (12.6, 20.9) ^a	6.8 (4.2, 9.4) ^a	6.2 (3.6, 8.7)	3.2 (1.5, 5.0)	4.4 (1.8, 7.1)	2.9 (0.7, 5.1)	5.2 (1.3, 9.2)	3.7 (1.5, 5.8)
Combustible tobacco	44.5 (39.1, 49.9)	39.3 (34.2, 44.4)	30.7 (25.7, 35.7)	28.1 (23.4, 32.8)				
Cigarettes	33.8 (28.6, 39.0)	29.8 (25.0, 34.7)	20.6 (16.2, 25.0)	18.5 (14.3, 22.6)	10.4 (7.9, 12.9)	9.3 (6.8, 11.8)	7.2 (5.2, 9.3)	5.3 (3.4, 7.1)
Hand-rolled cigarettes	18.3 (14.0, 22.6)	14.5 (10.6, 18.4)	8.5 (5.6, 11.5)	5.1 (2.9, 7.4)	3.6 (1.9, 5.3)	2.1 (0.6, 3.6)	4.8 (2.7, 6.9)	4.5 (1.4, 7.6)
Little cigars or cigarillos	21.7 (17.2, 26.2)	17.5 (13.6, 21.5)	10.0 (6.9, 13.1)	9.7 (6.8, 12.6)	3.2 (1.9, 4.6)	4.1 (2.4, 5.8)	3.3 (2.1, 4.5)	2.1 (1.6, 2.7)
Bidis	4.9 (2.6, 7.2)	5.0 (2.8, 7.3)	2.0 (0.7, 3.3)	3.1 (1.5, 4.8)	4.6 (0.4, 8.7)	3.8 (1.4, 6.1)	3.7 (1.3, 6.1)	3.8 (1.8, 5.8)
Tobacco pipe (bowls)	7.9 (4.9, 11.0)	5.8 (3.2, 8.3)	2.0 (0.7, 3.3)	1.7 (0.4, 3.0)	2.2 (0.0, 5.0)	1.4 (0.3, 2.6)	3.6 (1.7, 5.4)	2.3 (0.9, 3.7)
Cigars	16.4 (12.3, 20.6) ^a	8.4 (5.4, 11.5) ^a	8.4 (5.4, 11.4) ^a	2.5 (1.0, 4.1) ^a	2.3 (1.0, 3.7)	1.0 (0.3, 1.7)	3.2 (0.0, 6.4)	3.4 (1.6, 5.1)
Hookah (sessions)	12.5 (9.0, 16.1)	16.1 (12.3, 19.9)	4.5 (2.3, 6.6)	6.3 (3.9, 8.7)	1.6 (0.8, 2.4)	2.2(1.3, 3.1)	2.7 (0.7, 4.8)	4.9 (1.9, 7.9)
Vape products (sessions)	53.3 (47.9, 58.7)	50.8 (45.6, 56.1)	41.5 (36.1, 46.8)	38.8 (33.7, 43.9)				
Disposable vape	37.8 (32.6, 43.1)	35.3 (30.3, 40.4)	26.4 (21.7, 31.2)	27.7 (23.0, 32.4)	9.6 (7.6, 11.6)	9.9 (7.7, 12.1)	8.0 (5.9, 10.2)	8.9 (6.6, 11.1)
Puff Krush add-on	6.4 (3.9, 8.9)	8.2 (5.2, 11.2)	3.3 (1.7, 4.9)	5.1 (2.8, 7.4)	2.4 (1.1, 3.7)	5.2 (2.3, 8.1)	8.1 (0.0, 16.2)	6.1 (1.3, 11.0)
Rechargeable vape	31.0 (25.9, 36.1)	30.1 (25.2, 35.0)	19.8 (15.4, 24.1)	18.7 (14.6, 22.9)	8.6 (6.3, 11.0)	7.5 (5.4, 9.7)	9.5 (6.5, 12.6)	8.5 (5.6, 11.3)
Mod/Tank	30.7 (25.6, 35.8)	28.7 (23.8, 33.5)	18.0 (13.8, 22.2)	14.9 (11.2, 18.6)	7.7 (5.3, 10.0)	6.8 (4.5, 9.0)	9.8 (6.6, 13.0)	10.2 (6.8, 13.6)
Heat-not-burn vape	5.0 (2.7, 7.3)	5.8 (3.2, 8.4)	3.5 (1.6, 5.3)	4.3 (2.1, 6.6)	4.3 (1.9, 6.7)	4.7 (2.3, 7.2)	3.4 (1.1, 5.6)	3.7 (2.5, 4.9)
Cannabis Products								
Smoked marijuana (joints/blunts/bowls)	38.9 (33.7, 44.1)	41.6 (36.4, 46.8)	36.3 (31.2, 41.4)	35.1 (30.1, 40.1)	11.5 (9.4, 13.5)	11.3 (9.3, 13.4)	5.4 (3.9, 6.8)	5.1 (3.7, 6.5)
Simultaneous Marijuana and Tobacco	35.2 (30.1, 40.4)	34.6 (29.6, 39.7)	26.2 (21.6, 30.9)	27.8 (23.1, 32.5)				
Blunt ⁴	22.7 (18.2, 27.3)	23.3 (18.8, 27.9)	14.7 (10.9, 18.4)	17.4 (13.3, 21.5)	5.9 (4.1, 7.6)	6.5 (4.5, 8.5)	3.7 (2.1, 5.3)	3.1 (1.9, 4.4)
Spliff ⁴	24.3 (19.7, 28.9)	20.0 (15.8, 24.3)	14.9 (11.3, 18.5)	12.6 (9.2, 16.0)	6.5 (4.6, 8.5)	5.0 (3.2, 6.8)	4.6 (3.2, 6.0)	4.4 (2.9, 5.9)
Mole ⁴	15.4 (11.4, 19.5)	14.5 (10.6, 18.3)	8.8 (5.7, 11.9)	8.6 (5.5, 11.7)	5.7 (2.9, 8.4)	5.4 (2.6, 8.1)	4.2 (2.3, 6.2)	3.0 (1.9, 4.0)
Hookah and marijuana ⁴ (sessions)	11.3 (7.9, 14.6)	12.0 (8.8, 15.2)	5.5 (3.2, 7.7)	6.2 (4.1, 8.4)	5.0 (2.0, 7.9)	3.7 (1.8, 5.7)	7.9 (3.3, 12.4)	4.6 (2.9, 6.3)
Vaped marijuana (THC oil; sessions)	25.6 (20.9, 30.4)	27.2 (22.6, 31.9)	16.0 (12.1, 20.0)	16.2 (12.4, 19.9)	6.6 (4.5, 8.7)	5.5 (3.6, 7.4)	4.5 (3.0, 6.1)	5.0 (3.0, 7.1)
Dabbed marijuana (wax, shatter, crumble; sessions)	15.1 (11.2, 19.1)	17.7 (13.6, 21.9)	9.7 (6.3, 13.0)	10.1 (7.0, 13.3)	8.2 (4.8, 11.5)	7.8 (4.8, 10.9)	5.3 (2.3, 8.3)	5.7 (2.8, 8.5)
Edible (servings)	29.4 (24.4, 34.4)	29.9 (25.1, 34.6)	15.1 (11.3, 18.9)	16.3 (12.5, 20.1)	3.1 (2.1, 4.0)	3.0 (2.1, 4.0)	3.8 (1.8, 5.8)	2.4 (1.7, 3.2)
Topical (sessions)	5.4 (3.3, 7.6) ^a	12.0 (8.5, 15.5) ^a	3.6 (1.9, 5.2)	7.6 (4.8, 10.4)	6.6 (2.2, 11.0)	5.7 (2.7, 8.7)	7.0 (0.1, 13.9)	3.1 (1.5, 4.6)

Notes: ¹Ever used, even once; percent reflects weighted proportion of total sample (1,032). ²Use on > 1 day/last 30 days; percent reflects weighted proportion of total sample (1,032). ³For current users. ⁴Cannabis products that also contain tobacco. ⁵Unit is same as the product name (i.e., cigarette) unless indicated in parentheses. ^anon-overlapping CI reflects difference in prevalence or means.

2021 results suggest that this concern was substantiated. An industry watch on disposable e-cigarettes was called for in 2020 due to their marketing as a less expensive and more convenient alternative to rechargeable devices, and their relative lack of regulation (Williams, 2020; Delnevo et al., 2020). The volume capacity and nicotine strength of disposable e-cigarette devices have been steadily increasing, leading to a call for regulatory action (Diaz et al., 2023; Ali et al., 2023).

While vaping was the most common method of nicotine delivery in our young adult sample, nearly a third (29 %) reported current use of combustible tobacco, with cigarettes being the most common method.

There were few gender or racial/ethnic differences in nicotine product use in our sample of young adults, in contrast to a survey of the general U.S. adult population in 2021 finding higher rates of combustible smokeless tobacco among adult males and numerous racial/ethnic differences in tobacco use (Cornelius et al., 2023). The only gender or racial/ethnic difference in current tobacco use in our sample was higher cigar use among males, which aligned with 2021 results among the general U.S. adult population (Cornelius et al., 2023). The implication of our results is that prevention and treatment approaches for nicotine use among young adults should be broad. It is possible that the lack of many

Table 3

Weighted frequency (%; 95 % CI) of tobacco and cannabis product lifetime and current use; number of past 30 days used and typical quantity or frequency used (Mean; 95 % CI) in U.S. young adults in 2021, by race/ethnicity.

	Lifetime use ¹ % (95 % CI)			Current use ² % (95 % CI)			Number days used ³ Mean (95 % CI)			Quantity or Frequency used per day ^{3,5} Mean (95 % CI)		
	Non-Hispanic black N = 336	Non-Hispanic white N = 350	Hispanic any race N = 346	Non-Hispanic black N = 336	Non-Hispanic white N = 350	Hispanic any race N = 346	Non-Hispanic black	Non-Hispanic white	Hispanic any race	Non-Hispanic black	Non-Hispanic white	Hispanic any race
Tobacco Products												
Smokeless tobacco (dips/chews)	6.0 (3.4, 8.6) ^a	13.7 (10.2, 17.3) ^a	10.6 (6.9, 14.3)	3.6 (1.5, 5.7)	4.7 (2.5, 6.9)	6.0 (3.1, 8.8)	3.3 (1.2, 5.4)	3.7 (1.1, 6.2)	5.9 (2.8, 9.0)	4.9 (1.4, 8.4)	4.9 (0.8, 9.0)	4.0 (2.2, 5.8)
Combustible tobacco	38.6 (32.9, 44.4)	41.7 (36.5, 46.9)	46.4 (40.7, 52.4)	30.0 (24.6, 35.5)	28.3 (23.5, 33.1)	33.5 (28.0, 39.0)						
Cigarettes	19.4 (14.9, 23.9) ^{a, b}	35.0 (30.0, 40.1) ^a	31.9 (26.5, 37.3) ^b	14.0 (10.0, 17.9)	21.1 (16.8, 25.4)	19.0 (14.4, 23.6)	8.3 (5.6, 10.9)	10.7 (8.3, 13.0)	7.3 (5.1, 9.5)	5.4 (2.3, 8.6)	7.2 (5.3, 9.0) ^a	3.7 (2.2, 5.2) ^a
Hand-rolled cigarettes	9.3 (6.0, 12.6) ^a	18.6 (14.5, 22.7) ^a	15.0 (10.9, 19.2)	6.6 (3.7, 9.4)	6.5 (3.9, 9.2)	8.6 (5.2, 11.9)	4.9 (2.3, 7.6)	2.5 (1.1, 3.9)	3.9 (2.0, 5.9)	6.9 (1.8, 12.0)	4.6 (2.3, 6.8)	3.2 (1.2, 5.2)
Little cigars or cigarillos	18.7 (14.0, 23.3)	19.2 (15.0, 23.4)	22.5 (17.6, 27.4)	13.8 (9.6, 18.0)	7.8 (4.9, 10.7)	14.1 (10.1, 18.2)	6.3 (4.0, 8.5)	2.9 (1.4, 4.4)	3.7 (1.9, 5.5)	4.1 (2.4, 5.8)	1.8 (1.1, 2.4)	3.7 (1.7, 5.7)
Bidis	5.6 (2.9, 8.4)	4.5 (2.3, 6.7)	6.2 (3.4, 9.0)	4.7 (2.2, 7.1)	1.6 (0.3, 3.0)	4.2 (1.9, 6.4)	5.5 (2.4, 8.6)	3.4 (0.0, 7.0)	5.2 (1.0, 9.4)	6.8 (2.8, 10.9)	2.5 (0.6, 4.4)	3.7 (0.8, 6.5)
Tobacco pipe (bowls)	2.5 (0.6, 4.3) ^a	7.9 (5.1, 10.8) ^a	7.2 (4.2, 10.2)	1.6 (0.2, 3.0)	1.4 (0.2, 2.6)	4.0 (1.8, 6.2)	1.9 (0.3, 3.6)	1.6 (0.0, 3.8)	3.3 (1.0, 5.6)	2.6 (0.9, 4.2)	2.5 (1.3, 3.7)	3.9 (0.9, 6.8)
Cigars	7.0 (4.0, 10.0) ^a	14.2 (10.6, 17.9) ^a	11.4 (7.6, 15.3)	5.5 (2.8, 8.2)	5.3 (2.9, 7.6)	6.9 (3.8, 10.0)	4.2 (1.3, 7.2)	1.5 (0.4, 2.6)	2.5 (1.0, 4.0)	5.0 (0.3, 9.6)	3.3 (0.0, 7.1)	1.6 (0.9, 2.4)
Hookah (sessions)	11.2 (7.6, 14.8)	14.6 (11.0, 18.3)	15.9 (11.7, 20.1)	7.6 (4.5, 10.7)	4.2 (2.1, 6.4)	7.7 (4.6, 10.8)	6.3 (3.0, 9.6) ^a	1.0 (0.4, 1.5) ^a	2.4 (1.3, 3.6)	4.5 (2.3, 6.7)	4.4 (1.0, 7.8)	2.5 (1.4, 3.6)
Vape products (sessions)	46.2 (40.3, 52.1)	53.8 (48.6, 59.1)	51.2 (45.4, 57.1)	39.6 (33.8, 45.4)	39.4 (34.2, 44.6)	43.9 (38.1, 50.0)						
Disposable vape	32.6 (27.0, 38.1)	37.3 (32.2, 42.5)	37.9 (32.3, 43.5)	27.3 (22.1, 32.6)	25.8 (21.2, 30.5)	31.9 (26.4, 37.3)	9.9 (7.7, 12.2)	9.8 (7.7, 11.8)	9.5 (7.4, 11.7)	6.8 (4.8, 8.9)	9.3 (7.1, 11.5)	6.6 (4.5, 8.8)
Puff Krush add-on	6.5 (3.7, 9.4)	7.0 (4.4, 9.7)	9.0 (5.6, 12.4)	5.1 (2.6, 7.6)	3.3 (1.5, 5.2)	6.7 (3.8, 9.6)	9.0 (4.0, 13.9)	2.6 (0.3, 4.9)	4.7 (2.1, 7.3)	7.0 (2.3, 11.8)	7.6 (0.5, 14.7)	5.0 (0.7, 9.3)
Rechargeable vape	19.2 (14.6, 23.7)	34.2 (29.2, 39.2)	27.5 (22.3, 32.7)	15.5 (11.3, 19.7)	20.0 (15.7, 24.2)	20.2 (15.5, 24.9)	8.1 (5.7, 10.5)	8.2 (6.2, 10.3)	7.4 (5.0, 9.7)	5.4 (3.4, 7.4) ^a	10.4 (7.6, 13.3) ^a	6.0 (3.1, 8.9)
Mod/Tank	17.0 (12.6, 21.4) ^{a, b}	33.1 (28.1, 38.1) ^a	29.1 (23.8, 34.4) ^b	14.1 (9.9, 18.2)	16.2 (12.3, 20.1)	20.2 (15.5, 24.9)	7.6 (4.8, 10.4)	7.3 (5.2, 9.5)	6.6 (4.3, 8.8)	5.9 (3.1, 8.7)	11.9 (8.5, 15.3)	6.5 (3.8, 9.3)
Heat-not-burn vape	5.5 (2.8, 8.2)	5.3 (2.9, 7.7)	5.7 (2.9, 8.4)	4.7 (2.1, 7.4)	3.5 (1.6, 5.5)	4.5 (2.0, 7.0)	5.6 (3.4, 7.7)	4.0 (1.7, 6.4)	5.2 (1.5, 9.0)	4.8 (2.8, 6.8)	3.4 (1.6, 5.2)	2.4 (1.4, 3.5)
Cannabis Products												
Smoked marijuana (joint/blunt; bowl)	42.4 (36.6, 48.2)	39.5 (34.4, 44.6)	40.9 (35.2, 46.6)	42.8 (36.9, 48.6)	33.4 (28.5, 38.4)	37.7 (32.0, 43.3)	12.7 (10.6, 14.7)	11.5 (9.4, 13.6)	9.7 (7.7, 11.8)	6.8 (4.8, 8.8)	4.8 (3.4, 6.3)	5.0 (3.5, 6.5)
Simultaneous with Tobacco	35.2 (29.6, 40.9)	33.6 (28.6, 38.6)	40.0 (34.3, 45.7)	31.6 (26.1, 37.1)	25.1 (20.5, 29.7)	30.0 (24.7, 35.4)						
Blunt ⁴	17.5 (13.1, 22.0)	24.0 (19.5, 28.6)	24.6 (19.6, 29.7)	14.8 (10.6, 18.9)	16.0 (12.1, 19.9)	17.2 (12.8, 21.6)	10.1 (7.2, 13.1) ^a	5.4 (3.6, 7.1) ^a	6.5 (4.2, 8.8)	4.9 (2.6, 7.1)	3.0 (1.8, 4.3)	3.6 (1.4, 5.8)
Spliff ⁴	21.3 (16.5, 26.1)	22.1 (17.7, 26.5)	23.6 (18.5, 28.6)	19.0 (14.4, 23.7)	11.3 (7.9, 14.6)	18.7 (14.0, 23.4)	9.9 (7.4, 12.4) ^a	4.2 (2.3, 6.0) ^a	8.7 (6.0, 11.4)	6.4 (4.1, 8.8)	3.3 (2.1, 4.5)	5.7 (3.0, 8.3)
Mole ⁴	5.8 (3.2, 8.3) ^{a, b}	17.4 (13.4, 21.4) ^a	14.7 (10.6, 18.9) ^b	4.3 (2.0, 6.6)	9.5 (6.4, 12.6)	10.2 (6.6, 13.8)	4.0 (1.4, 6.6)	5.1 (2.7, 7.5)	8.1 (4.6, 11.7)	2.1 (1.2, 3.1)	3.3 (2.2, 4.5)	5.2 (1.5, 8.9)
Hookah and marijuana ⁴	13.3 (9.3, 17.3)	10.2 (7.1, 13.4)	15.5 (11.4, 19.7)	10.7 (7.0, 14.4) ^a	3.9 (1.9, 5.9) ^a	8.5 (5.4, 11.7)	4.5 (2.3, 6.7)	4.3 (1.6, 7.0)	4.4 (1.6, 7.2)	3.1 (1.8, 4.5)	8.1 (3.8, 12.5)	5.3 (2.4, 8.2)
Vaped marijuana (THC oil; sessions)	21.0 (16.2, 25.8)	27.7 (23.0, 32.5)	26.7 (21.6, 31.7)	15.8 (11.5, 20.1)	15.6 (11.8, 19.4)	18.5 (14.1, 22.8)	7.2 (5.1, 9.4)	5.7 (3.8, 7.6)	6.4 (4.2, 8.6)	6.4 (4.0, 8.8) ^a	4.4 (2.5, 6.2) ^a	5.0 (2.9, 7.0)

(continued on next page)

Table 3 (continued)

	Lifetime use ¹ % (95 % CI)			Current use ² % (95 % CI)			Number days used ³ Mean (95 % CI)			Quantity or Frequency used per day ^{3,5} Mean (95 % CI)		
	Non-Hispanic black N = 336	Non-Hispanic white N = 350	Hispanic any race N = 346	Non-Hispanic black N = 336	Non-Hispanic white N = 350	Hispanic any race N = 346	Non-Hispanic black	Non-Hispanic white	Hispanic any race	Non-Hispanic black	Non-Hispanic white	Hispanic any race
Dabbed marijuana (wax, shatter, crumble; sessions)	8.9 (5.7, 12.0) ^a	18.7 (14.7, 22.8) ^a	14.7 (10.6, 18.8)	5.2 (2.7, 7.6) ^a	11.4 (8.1, 14.7) ^a	8.7 (5.5, 12.0)	8.1 (4.5, 11.7)	8.2 (5.4, 11.1)	6.5 (3.5, 9.5)	5.0 (2.6, 7.3)	5.6 (2.9, 8.3)	5.0 (2.0, 8.0)
Edible (servings)	23.6 (18.7, 28.4) ^a	31.5 (26.6, 36.3) ^a	28.3 (23.1, 33.4)	16.7 (12.4, 21.0)	14.8 (11.1, 18.6)	18.1 (13.7, 22.5)	6.5 (4.3, 8.7) ^a	2.1 (1.3, 2.9) ^a	4.3 (2.9, 5.7)	3.2 (2.3, 4.1)	3.1 (1.5, 4.7)	3.1 (1.8, 4.4)
Topical (sessions)	8.8 (5.5, 12.0)	8.1 (5.3, 10.9)	10.6 (7.3, 13.9)	6.5 (3.6, 9.4)	4.8 (2.6, 7.0)	7.6 (4.9, 10.4)	8.1 (4.1, 12.1)	5.4 (1.7, 9.0)	6.2 (4.0, 8.4)	6.9 (1.3, 12.6)	3.7 (0.0, 8.3)	4.6 (1.7, 7.6)

Notes: ¹Ever used, even once; percent reflects weighted proportion of total sample (1,032). ²Use on > 1 day/last 30 days; percent reflects weighted proportion of total sample (1,032). ³For current users. ⁴Cannabis products that also contain tobacco. ⁵Unit is same as the product name (i.e., cigarette) unless indicated in parentheses. ^a, ^bnon-overlapping CI reflects difference in prevalence or means.

demographic differences in nicotine use reflects homogeneity among young adults who vape nicotine at rates higher than any other age group (Schulenberg et al., 2020).

Combustible cannabis use was reported by over a third of our sample (36 %), aligning with smoking being the most common route of administration in previous national surveys of U.S. young adults (Hammond et al., 2022; Romm et al., 2021). There were no gender differences in current cannabis product use in our sample, while there were several racial/ethnic differences. Use of four cannabis administration methods were heavier among NHB than NHW individuals: blunts and spliffs were used on twice as many days, edibles were used on three times as many days, and vaping sessions were nearly double. Current prevalence of cannabis and tobacco in a hookah was also higher. The more frequent use of some cannabis products among non-Hispanic Black young adults aligns with greater monthly spending on cannabis products and flower cannabis consumption along with no differences in purchasing source (D'Amico et al., 2020).

Three of these methods were simultaneous use of tobacco and cannabis, and given greater abuse liability associated with simultaneous use, (Schauer et al., 2017; Tullis et al., 2003) this finding reveals an important health disparity (Rubenstein et al., 2020; Schauer et al., 2017). Greater levels of blunt use among African American young adults have been previously documented (Mantey et al., 2021; Mantey et al., 2024) as has the relatively greater level of cannabis withdrawal symptoms and economic cost among those who use cannabis and nicotine combined in blunts versus cannabis alone in joints (Montgomery et al., 2019) It has been suggested that factors including retail density and marketing in African American communities may be responsible for higher rates of blunt use and that regulatory actions may be needed to address this disparity (Mantey et al., 2024). Continued surveillance of specific formulations and methods of cannabis and tobacco administration by racial/ethnic group are recommended.

Dabbing, for which some individuals use specialized equipment, (Mullins, 2023, 2021) was among the less frequently used routes of administering cannabis in our sample. However, dabbing was more common among NHW (11 %) than NHB (5 %). Furthermore, dabbing was more common in states where cannabis was fully legal (14 %) than illegal (7 %), as well as more frequent in legal (7 sessions/day) than illegal (3 sessions) states. There were no other differences in cannabis product use by state legality, except for past 30-day blunt use being heavier in states where cannabis was illegal (8 days) than legal (4 days). Previous studies have found that cannabis formulation use varies by legality, with one study finding odds of vaping versus smoking being higher in states where cannabis was legal, (Romm et al., 2021) and use of formulations other than smoking rising in states in which cannabis

was legal (Hammond et al., 2022). It is possible that our more conservative method of using non-overlapping confidence intervals to compare estimates did not find some differences that would be detected using inferential testing (Schenker and Gentleman, 2001). Given the different risk profiles of various cannabis formulations, (MacCallum et al., 2023; Meehan-Atrash et al., 2019) the impact of cannabis legality on methods of cannabis used by young adults will be important to monitor.

Study findings must be viewed in light of limitations. Retrospective survey assessment of cannabis and tobacco use is subject to recall bias. It is recommended that future studies use methods such as timeline followback (Hjorthøj et al., 2012; Robinson et al., 2014) and ecological momentary assessment (Berg et al., 2019; Buu et al., 2023). Furthermore, results are not representative of the entire U.S. population and future studies including a full range of racial/ethnic and gender identity groups across the U.S. are warranted. Our study was not hypothesis-driven and therefore did not involve an a-priori power analysis, yet the large group differences we detected appear meaningful. We recommend that large surveillance studies investigate group differences in both cannabis and tobacco to identify small meaningful differences. Future studies testing specific hypotheses about group differences may consider inferential testing (Schenker and Gentleman, 2001).

4.1. Conclusions

In the current study, dual use of cannabis and tobacco was dominant among young adults. Given the dynamic regulatory landscape, continued monitoring of specific cannabis and tobacco product use is recommended. Trends in simultaneous use of cannabis and tobacco and associated adverse effects warrant continued assessment to inform prevention and treatment approaches, including identifying specific modalities, motives for use, and populations most likely to use them (McClure et al., 2020).

Declaration of generative AI and AI-assisted technologies in the writing process

No generative AI or AI-assisted technologies were used in the writing of this manuscript.

Disclosures

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Table 4

Weighted frequency (%; 95 % CI) of tobacco and cannabis product lifetime and current use; number of past 30 days used and typical quantity or frequency used (Mean; 95 % CI) in U.S. young adults in 2021, by state legality.

	Lifetime Use ¹ % (95 % CI)		Current Use ² % (95 % CI)		Number Days Used ³ Mean (95 % CI)		Quantity or Frequency Used per Day ^{3, 5} Mean (95 % CI)	
	Illegal N = 513	Legal N = 519	Illegal N = 513	Legal N = 519	Illegal	Legal	Illegal	Legal
Tobacco Products								
Smokeless tobacco (dips/chews)	10.0 (6.8, 13.3)	14.2 (10.4, 18.1)	3.5 (1.7, 5.4)	6.2 (3.5, 8.9)	5.1 (1.3, 8.9)	3.0 (1.3, 4.8)	6.6 (0.0, 13.2)	3.4 (2.1, 4.8)
Combustible tobacco	42.4 (37.2, 47.6)	41.4 (36.2, 46.7)	30.8 (25.9, 35.7)	27.8 (23.1, 32.5)				
Cigarettes	31.3 (26.3, 36.3)	32.5 (27.5, 37.6)	20.3 (16.0, 24.7)	18.6 (14.4, 22.8)	10.7 (8.1, 13.4)	8.9 (6.5, 11.2)	6.8 (4.9, 8.8)	5.8 (3.8, 7.9)
Hand-rolled cigarettes	15.9 (11.9, 19.9)	17.1 (13.0, 21.3)	6.4 (3.9, 8.9)	7.5 (4.6, 10.3)	2.6 (1.5, 3.7)	3.3 (1.2, 5.4)	4.9 (2.6, 7.1)	4.6 (1.9, 7.2)
Little cigars or cigarillos	19.8 (15.6, 23.9)	19.5 (15.2, 23.8)	11.1 (8.0, 14.2)	8.4 (5.5, 11.2)	4.9 (3.1, 6.6) ^a	2.0 (1.0, 3.0) ^a	3.3 (2.1, 4.5)	2.2 (1.5, 2.9)
Bidis	5.1 (2.9, 7.2)	4.9 (2.5, 7.3)	2.6 (1.2, 4.0)	2.5 (0.9, 4.1)	5.5 (1.5, 9.5)	2.5 (0.4, 4.7)	5.0 (2.3, 7.7)	2.2 (1.2, 3.3)
Tobacco pipe (bowls)	6.0 (3.4, 8.6)	8.0 (4.9, 11.0)	1.8 (0.5, 3.0)	2.0 (0.6, 3.4)	1.3 (0.4, 2.1)	2.5 (0.0, 5.8)	2.8 (0.9, 4.8)	3.1 (1.8, 4.4)
Cigars	11.4 (8.0, 14.8)	13.9 (10.0, 17.8)	5.9 (3.5, 8.3)	5.1 (2.7, 7.5)	2.3 (1.0, 3.7)	1.4 (0.2, 2.7)	4.4 (0.0, 8.7)	1.6 (0.8, 2.4)
Hookah (sessions)	10.4 (7.2, 13.6) ^a	19.0 (14.7, 23.2) ^a	5.0 (2.9, 7.2)	5.8 (3.4, 8.1)	3.1 (1.8, 4.4) ^a	1.2 (0.7, 1.7) ^a	3.9 (1.9, 5.9) ^a	4.2 (0.8, 7.5) ^a
Vape products (sessions)	51.9 (46.6, 57.2)	52.4 (47.0, 57.7)	40.9 (35.7, 46.1)	39.2 (34.0, 44.4)				
Disposable vape	35.0 (29.9, 40.1)	38.6 (33.3, 43.8)	27.5 (22.8, 32.3)	26.5 (21.8, 31.1)	11.5 (9.2, 13.8)	7.8 (6.0, 9.6)	8.6 (6.5, 10.8)	8.1 (6.0, 10.3)
Puff Krush add-on	6.9 (4.2, 9.5)	7.8 (4.9, 10.6)	3.5 (1.7, 5.4)	4.9 (2.8, 7.1)	3.6 (1.7, 5.5)	4.3 (1.4, 7.2)	6.0 (2.1, 9.9)	7.5 (0.7, 14.4)
Rechargeable vape	28.8 (23.9, 33.7)	32.7 (27.5, 37.8)	18.3 (14.2, 22.5)	20.4 (16.0, 24.7)	8.0 (5.8, 10.2)	8.2 (6.0, 10.5)	8.7 (5.8, 11.6)	9.4 (6.4, 12.4)
Mod/Tank	30.3 (25.3, 35.2)	29.1 (24.1, 34.0)	17.4 (13.3, 21.4)	15.4 (11.6, 19.3)	7.4 (5.1, 9.7)	7.0 (4.7, 9.4)	9.0 (5.8, 12.1)	11.1 (7.6, 14.5)
Heat-not-burn vape	6.8 (4.1, 9.5)	3.7 (1.8, 5.6)	5.2 (2.9, 7.6)	2.3 (0.8, 3.7)	4.7 (2.6, 6.8)	4.1 (1.0, 7.2)	3.8 (2.1, 5.4)	2.8 (1.9, 3.8)
Cannabis Products								
Smoked marijuana (joints/blunts/bowls)	35.0 (30.0, 40.0) ^a	46.7 (41.3, 52.0) ^a	33.4 (28.5, 38.3)	38.5 (33.3, 43.7)	11.7 (9.6, 13.9)	11.1 (9.1, 13.1)	5.3 (3.7, 6.9)	5.2 (3.9, 6.5)
Simultaneous Marijuana and Tobacco	33.8 (28.8, 38.8)	36.3 (31.2, 41.5)	26.8 (22.2, 31.4)	27.2 (22.5, 32.0)				
Blunt ⁴	23.1 (18.6, 27.7)	22.9 (18.4, 27.4)	16.7 (12.7, 20.6)	15.1 (11.3, 19.0)	7.9 (5.7, 10.3) ^a	4.0 (2.9, 5.2) ^a	3.9 (2.3, 5.4)	2.8 (1.7, 3.9)
Spliff ⁴	20.2 (15.9, 24.5)	24.7 (20.0, 29.4)	12.4 (9.1, 15.7)	15.5 (11.7, 19.2)	5.6 (3.7, 7.4)	6.2 (4.2, 8.2)	5.0 (3.6, 6.4)	4.0 (2.6, 5.5)
Mole ⁴	13.4 (9.7, 17.2)	16.8 (12.7, 21.0)	8.8 (5.6, 11.9)	8.7 (5.7, 11.7)	6.8 (3.6, 10.0)	4.2 (2.0, 6.4)	3.3 (2.1, 4.5)	3.8 (2.0, 5.7)
Hookah and marijuana ⁴ (sessions)	9.2 (6.4, 12.1)	14.6 (10.8, 18.4)	5.5 (3.4, 7.5)	6.3 (3.8, 8.7)	2.9 (1.7, 4.1)	5.5 (2.5, 8.5)	3.6 (2.2, 4.9)	8.4 (4.2, 12.6)
Vaped marijuana (THC oil; sessions)	24.3 (19.7, 28.9)	29.0 (24.1, 34.0)	14.9 (11.2, 18.7)	17.5 (13.5, 21.6)	5.7 (3.8, 7.5)	6.4 (4.3, 8.6)	4.9 (3.2, 6.7)	4.7 (2.7, 6.6)
Dabbed marijuana (wax, shatter, crumble; sessions)	13.0 (9.3, 16.7)	20.6 (16.1, 25.0)	6.8 (4.0, 9.6) ^a	13.7 (9.9, 17.5) ^a	5.3 (2.3, 8.4)	10.0 (6.8, 13.2)	2.7 (1.9, 3.5) ^a	7.4 (3.9, 10.8) ^a
Edible (servings)	24.9 (20.2, 29.5) ^a	35.4 (30.3, 40.6) ^a	13.2 (9.7, 16.7)	18.7 (14.6, 22.9)	3.5 (2.4, 4.7)	2.6 (1.9, 3.4)	2.7 (2.0, 3.4)	3.5 (1.6, 5.4)
Topical (sessions)	8.4 (5.6, 11.1)	8.9 (5.9, 11.9)	5.8 (3.5, 8.1)	5.2 (3.0, 7.5)	7.7 (3.7, 11.6)	4.0 (1.6, 6.8)	3.6 (1.5, 5.7)	5.8 (0.0, 11.7)

Notes. ¹Ever used, even once; percent reflects weighted proportion of total sample (1,032). ²Use on > 1 day/last 30 days; percent reflects weighted proportion of total sample (1,032). ³For current users. ⁴Cannabis products that also contain tobacco. ⁵Unit is same as the product name (i.e., cigarette) unless indicated in parentheses. ^anon-overlapping CI reflects difference in prevalence or means.

appeared to influence the work reported in this paper.

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Kim Pulvers: Writing – original draft, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization. **Nessa Jamalian:** Writing – review & editing, Resources. **Edleen Suh:** Writing – review & editing, Resources. **Peter Faltaos:** Writing – review & editing, Investigation. **Susan L. Stewart:** Writing – review & editing, Supervision, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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