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Prevalence, Trends, and Distribution of Nicotine and Marijuana use in E-cigarettes among US adults: The Behavioral Risk Factor Surveillance System 2016-2018

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Abstract

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Use of substances other than nicotine in e-cigarettes, especially marijuana, is becoming increasingly popular in the US. However, population-representative data on such poly-use (nicotine and marijuana) remains limited. We therefore conducted a cross-sectional logistic regression analysis of the 2018 Behavioral Risk Factor Surveillance System among 16 US states/territories with data on past 30-day marijuana use to describe the emerging dual nicotine and marijuana vaping population. We additionally examined trends in marijuana use, including marijuana vaping, from 2016 to 2018.

Of the 131,807 participants studied, 3,068 were current e-cigarette users, among whom 7.1% also vaped marijuana. Prevalence of nicotine-predominant, dual nicotine marijuana, and marijuana-predominant vaping was 3.36%, 0.38% and 1.09%, respectively. Compared to nicotine-predominant vapers, dual and marijuana-predominant vapers were older, had greater proportions of non-Whites, particularly Hispanics, and less likely to be current smokers (nicotine-predominant vs dual vs marijuana-predominant vaping: current tobacco use 44.7 vs 23.7 vs 11.1%). Proportion of dual vapers among current e-cigarette users was 8.6%, 2.6% and 7.1% for 2016, 2017 and 2018, respectively. Prevalence of marijuana use increased from 8.97% (2016) to 13.1% (2018) while no clear trend was observed for marijuana vaping.

Dual nicotine and marijuana vaping is prevalent in the US, and compared to predominantly nicotine vapers such users have higher mean ages, and are more likely to be Blacks, Hispanics, and never cigarette smokers. Marijuana use overall increased from 2016 to 2018. Dual vapers represent a large and important emerging population that will require dedicated study of health effects and tailored regulatory strategies.

Keywords

Electronic cigarettes; Tobacco; Marijuana; Vaping; EVALI; Prevalence; Surveys

Introduction

Electronic cigarettes (e-cigarettes) are battery-powered devices that deliver aerosol to users by heating a solution typically containing nicotine, flavors, and other chemicals. E-cigarettes are one of the most popular tobacco products in the US.[1,2] Their popularity and appeal especially among youth and young adults, including among those who previously did not smoke cigarettes, have made e-cigarettes an important public health concern.[3] Due to the evolving epidemiology of e-cigarettes, it is crucial to monitor changes in their use patterns. An emerging pattern seen among a subpopulation of vapers is the use of substances besides nicotine in e-cigarettes. Such substances include vaping alcohol, marijuana, and herbs and supplements, with marijuana and alcohol being the most popular.[4,5] For instance, around 7% of e-cigarette users in a university population were found to have used substances other than nicotine in their e-cigarettes, the majority of whom used marijuana (78%).[5] Additionally, a 2017 study of US adults aged ≥18 years reported that a substantial 4.7% of adults reported vaping marijuana in the previous year.[6]

In June-November 2019, there was an outbreak of over 2,500 e-cigarette, or vaping, product use associated lung injury (EVALI) cases across the US. Concerningly, most of the cases

were reported to have used marijuana-related products or a poly-use of marijuana and nicotine in their e-cigarettes.[7-9] The outbreak prompted the Centers for Disease Control and Prevention (CDC) to issue a Health Advisory alert and take an unprecedented step of recommending refraining from e-cigarette use particularly for youth, young adults, pregnant women, and non-cigarette smoking adults.[10] The EVALI outbreak underscores the potential dangers of e-cigarette use and highlights a crucially-needed focus on an emerging marijuana vaping population.

The increasing legalization of marijuana across the US, in addition to the rapid rise in overall e-cigarette use, mandates study of a new sub-population of dual marijuana and e-cigarette users. There is however paucity of data on the size and characteristics of such a 'dual vaping' population, and the marijuana vaping population in general. Individuals vaping marijuana may be different from conventional nicotine vapers and may therefore need tailored health education, health promotion, and other preventive interventions.

Therefore, using the largest and most contemporary US survey of e-cigarette use to date, the Behavioral Risk Factor Surveillance System (BRFSS), we sought to (1) Describe the size and characteristics of the emerging dual nicotine and marijuana vaping population, and (2) Examine trends in marijuana use in the US from 2016 to 2018, with a particular focus on marijuana vaping.

Methods

Study design and setting

For the primary cross-sectional descriptive analysis, we used data from 2018, the most up to date cycle of BRFSS. The BRFSS is an extensive, nationally representative telephone survey conducted by the CDC jointly with all the states and participating territories of the US. For the analysis of trends, we additionally used data from 2016, 2017 and 2018 BRFSS. All analyses focused on the states and territories for which marijuana data was available for each year; 12 states/territories provided data in 2016 and 2017 and 16 states/territories provided data in 2018. Since different number of states provided marijuana data over the three years, we focused the trends analysis primarily on the six states that provided marijuana data for each of the three years. These consistent states were California, Idaho, Minnesota, Oklahoma, Tennessee and Wyoming. These states/territories had varying legal statuses on marijuana use and are described in Supplemental Tables 3 and 4. The median survey response rate for all states and territories for the 2018 BRFSS was 53.3% for landline telephone and 43.4% for cell phone, and the overall combined median response rate was 49.9%. Response rates for BRFSS are calculated using the response rate formula of the American Association for Public Opinion Research.

Study population and E-cigarette and Marijuana use assessment

We included 131,807 participants aged 18 years or older from the 2018 BRFSS. To assess e-cigarette use, participants were asked, "Have you ever used an e-cigarette or other electronic 'vaping' product, even just one time, in your entire life?" Those who answered yes were then asked a second question: "Do you now use e-cigarettes or other electronic 'vaping'

products every day, some days, or not at all?" Participants who responded "every day" and "some days" were considered current e-cigarette users.

For 2017 and 2018 BRFSS, the (nicotine) e-cigarette question included a note for interviewer specifically on nicotine and marijuana: "Interviewer note: These questions concern electronic vaping products for nicotine use. The use of electronic vaping products for marijuana use is not included in these questions." For 2016 BRFSS, however, this note was not included, possibly because poly-substance use in e-cigarettes was not as common at the time.

To assess marijuana use, participants were asked, "During the past 30 days, on how many days did you use marijuana or cannabis?" Those who responded any use were then asked, "During the past 30 days, which one of the following ways did you use marijuana the most often?". Participants who responded affirmatively to the option "Vaporize it (for example, in an e-cigarette-like vaporizer or another vaporizing device)" were considered marijuana vapers. This included participants who used marijuana via vaping only, and those who vaped marijuana in addition to using via other modes (such as smoking, eating, drinking, and dabbing).

Participants who were current e-cigarette users and who also vaped marijuana were considered "dual vapers". Conversely, those who were current e-cigarette users and did not vape marijuana were considered "nicotine-predominant vapers". Those who were marijuana vapers and were not dually vaping nicotine were considered as "marijuana-predominant" vapers. We chose the "predominant" label since it is possible that participants might have used other substances besides nicotine/marijuana in their e-cigarettes.

Study variables

Key demographic and socioeconomic variables included age, sex, race/ethnicity, education, and income level. Health-related characteristics included depression, BMI and smoking status. Household income was reported according to the federal poverty guidelines of 2018, taking into consideration the number of persons in family/household.[11] Depression was defined as a history of clinical diagnosis if participants responded yes to the question, "Has a physician ever told you have a depressive disorder (including depression, major depression, dysthymia, or minor depression)?" Body mass index (BMI) was calculated using reported height and weight. Smoking status was categorized as current, former and never. All variables were self-reported.

Statistical Analysis

We first merged the core and optional BRFSS datasets according to the BRFSS marijuana analytic module for the 16 states with data on marijuana use for 2018.[12,13] We calculated the weighted prevalence of current e-cigarette use and marijuana vaping according to the 2018 BRFSS analytic guidelines.[14] For prevalence calculations by sociodemographic sub-groups, participants with missing information on the sub-group of interest were excluded. We generated estimates of the number of nicotine and marijuana vapers in the US by applying nationally-representative prevalence estimates to US Census Bureau's projection of number of adults in 2018.[15,16] We conducted multivariable logistic regression analyses

comparing factors associated with (1) Dual vaping (vs nicotine-predominant vaping) and (2) Marijuana-predominant vaping (vs nicotine-predominant vaping). The following covariates were included in all the models: age, sex, race, education, poverty level, clinical depression, BMI and smoking status. We used the *svy* command to account for the complex survey design. Marijuana use prevalence was analyzed by year and absolute differences in prevalence were calculated with the *lincom* command. All analyses were performed using Stata v14.2 (Statacorp, College Station, TX).

Results

We included a total of 131,807 BRFSS participants aged 18 years or older from the 2018 BRFSS. Median age category of the current e-cigarette using population was 35-39 years. Additionally, 41.4% of the population were females. The prevalence of current e-cigarette use was 5.4% (95% CI, 5.0-5.8%). Median age category of marijuana vapers was 40-44 years and 38.5% were females. The prevalence of marijuana vaping was 1.3% (95% CI, 1.2-1.5%).

Figure 1 shows the 3 populations examined in the study. There was a total of 2,904 current e-cigarette users who were nicotine-predominant vapers, and 164 current e-cigarette users who also vaped marijuana (dual nicotine marijuana vapers). Dual vapers thus made up 7.1% (weighted proportion) of the current e-cigarette user population. Additionally, there was a total of 734 marijuana vapers, which was comprised of 164 aforementioned dual vapers and 570 marijuana-predominant vapers. The prevalence of the 3 populations were as follows: nicotine-predominant vapers (3.36%); dual nicotine marijuana vapers (0.38%) and marijuana-predominant vapers (1.09%).

Table 1 shows the sociodemographic and health-related characteristics of the three groups. Adults in the 18-24 year age group made up 17.2% and 18.3% in the dual and marijuana-predominant vaping population, respectively, compared to 33.2% in the nicotine-predominant population. Approximately 19.7% of dual vapers were 45-69-years old, compared to 30.7% of marijuana-predominant vapers in the same age category.

Males constituted the majority of vapers in all three populations. Similarly, adults with some college education and those with family income greater than the poverty level constituted the majority of all three populations, which was even more pronounced in the dual and marijuana-predominant vaping populations. Though Whites made up the largest racial/ethnicity group in the three populations, dual and marijuana-predominant vapers had greater proportions of non-Whites – particularly Hispanics – compared to nicotine-predominant vapers. Dual vapers also had a greater proportion of Blacks compared to the other two populations.

Never and former smokers made up the majority of dual and marijuana-predominant vapers, whereas current smokers were preponderant among nicotine-predominant vapers. For instance, about half of marijuana-predominant vapers (54.5%) were never smokers, while close to half of nicotine-predominant vapers (44.7%) were current smokers.

Table 2 shows multivariable adjusted logistic regression analysis to assess the association between sociodemographic and health factors, and patterns of vaping.

Dual vapers vs nicotine-predominant vapers:

There is a significant association of dual vaping with increasing age, compared to nicotine-predominant vapers when adjusting for other covariates. For instance, compared to 18-24-year-olds, adults who are 24-44 and 45-69 years old have 3.44- and 2.74-times higher odds, respectively, to be dual vapers. Similarly, Blacks and Hispanics have higher odds to be dual vapers than Whites. When it comes to smoking, never and former smokers are significantly likely to be dual vapers compared to current smokers.

Marijuana-predominant vapers vs nicotine-predominant vapers:

Older adults are more likely to be marijuana-predominant vapers than younger adults when adjusting for other covariates. Hispanics have higher odds to be marijuana-predominant vapers than Whites. Males are more likely than females to be marijuana-predominant vapers. Never smoking and former smoking are also highly associated with marijuana-predominant vaping compared to current smoking.

Figure 2 and Supplemental Table 1 shows the trends in prevalence of past 30-day marijuana use from 2016-2018 for the six states that provided marijuana data each year. There was a graded increase in any marijuana use across the US from 8.97% in 2016 to 13.1% in 2018 corresponding to an absolute increase of +4.18% in prevalence. Around the same period, prevalence of marijuana vaping decreased from 1.99% in 2016 to 1.13% in 2017 then followed by an increase to 1.63% in 2018. Repeating the analyses among all states that provided marijuana data show similar pattern of increase in the prevalence of any marijuana use and marijuana vaping. (Supplemental Table 1).

Among all states that provided marijuana data, there was a dip in the proportion of dual vapers among current e-cigarette users in 2017 to 2.6%, then followed by an increase in the proportion to 7.1% in 2018. Additionally, assessing in the six states that provided marijuana data for all 3 years showed a similar pattern of change in the proportion. (Supplemental Table 1 and Supplemental Figure).

Table 3 shows the prevalence of marijuana vaping (dual and marijuana-predominant) among different sociodemographic groups for 2018. Prevalence was highest among adults aged 18-24 years (2.1%), corresponding to 640,000 marijuana vapers in the US. Prevalence was also high among males (1.7%), Hispanics (1.6%), and among former smokers (1.9%).

Supplemental Table 2 shows trends in prevalence of marijuana use by the six consistent states from 2016-2018 by individual state. The prevalence of any marijuana use varied by state, ranging from 8.49% in Wyoming to 14.9% in California in 2018. Similarly, prevalence of marijuana vaping also varied by state. Overall, prevalence of any marijuana use increased for all states from 2016 to 2018, despite varying legal statuses on marijuana use over the time period.

Supplemental Table 3 shows the US states and territories that provided marijuana data in BRFSS in 2016, 2017 and 2018. Supplemental Table 4 shows the legal statuses of marijuana use in the 16 states/territories of BRFSS 2018.

Discussion

We describe the characteristics of nicotine and marijuana poly-use in e-cigarettes among US adults using the BRFSS, a large nationally representative survey. We report that 7.1% of current e-cigarette users also vape marijuana in 2018. We also report an increase in any marijuana use overall and in each of the six consistent states over this time period. The emerging population of marijuana vapers – including dual nicotine and marijuana vapers – on average are somewhat older, and more likely to be males, and never smokers compared to e-cigarette users who predominantly vape nicotine. Importantly, we also project that there are approximately 640,000 marijuana vapers (dual and marijuana-predominant) aged 18-24 years in the US in 2018.

Our estimates were generally similar across sociodemographic patterns, with greater e-cigarette use in all three groups among males, Whites, those with some college education, and those with family income greater than the poverty level. However, nicotine-predominant vapers were relatively younger than marijuana vapers (dual and predominant). This difference in age composition could be due to the tremendous rise in nicotine e-cigarette use in recent years, especially among youth and younger adults.[17] This rise in e-cigarette use was partly contributed by aggressive marketing strategies of e-cigarette brands such as JUUL, which rose from 0% of US market share in 2016 to being the most dominant e-cigarette product in 2019.[18-20]

We found marijuana vaping in 2018 to be more prevalent among younger adults compared to older. For instance, we report that the prevalence of marijuana vaping was the highest among 18-24 years of age (2.1%), compared to other age groups. Our findings are similar to that reported by Steigwald et al. in 2017 who reported the highest prevalence of marijuana vaping among the 18-34-year (8%) and 35-49-year (5.7%) age categories.[6] However, our prevalence estimates are smaller since we reported past 30-day use whereas they reported past-year use. In addition, similar to their findings, we found marijuana vaping prevalence to be highest among Hispanics. While there has been an increase in marijuana use in multiple race/ethnicity groups including Hispanics in recent years,[21,22] it is important to note the highest vaping prevalence in this group. However, there is limited data on marijuana use in e-cigarettes, more so by race/ethnicity groups. Further research will help explain potential determinants and implications of marijuana vaping in such groups.

E-cigarette use among never smokers (i.e. among those with no history of smoking traditional cigarettes) is concerning as it has been associated with increased transition to cigarette smoking among these adults.[3] Importantly, marijuana use has also been linked with cigarette smoking initiation (“reverse gateway effect”).[23] Thus it is concerning that 32.1% and 54.5% of dual vapers and marijuana-predominant vapers were never smokers, respectively, compared to 24% of nicotine-predominant vapers in our analysis, with implications for increased transition to cigarette smoking especially among the marijuana

vapers. Additionally, a sizeable portion of these 2 sub-populations were current smokers (~24% and 11% of dual and marijuana-predominant vapers, respectively) which highlights greater polysubstance use in these 2 groups.

In our study, we report some of the most up to date data on dual nicotine and marijuana vaping, showing a decrease in the proportion of dual vapers among current e-cigarette users from 2016 to 2017 followed by an increase in 2018. There is, however, limited data on poly-use of nicotine and marijuana in e-cigarettes. In 2016, Kenne et al. observed that 7% (107/1524) of e-cigarette users in a university population reported other substance use in e-cigarettes, which is similar to our 2016 estimate of 8.6%.[5] While no clear trend was observed in our analysis, we speculate a possible increase in dual vaping among current e-cigarette users in upcoming years given the increased legalization of marijuana in the US. We additionally report that past 30-day marijuana use prevalence increased from 7.5% (2016) to 11.1% (2018). Similarly, a rise in marijuana use has also been reported by the National Survey on Drug Use and Health (NSDUH) with prevalence rising from 9.1 %(2016) to 10.5% (2018).[22]

Our study helps to quantify an important emerging pattern among e-cigarette use. Though our poly-use estimate of 7.1% in 2018 might seem low, it is likely that poly-use of nicotine and marijuana in e-cigarettes will continue to expand in the future, given increasing legalization of marijuana and increase in e-cigarette use. In addition, poly-use has received significant attention because the 2019 EVALI outbreak involved many cases of e-cigarettes containing marijuana in addition to nicotine.[7] Blount et al. reported that vitamin E acetate, which is used as an additive in THC-containing e-cigarettes, was closely associated with EVALI.[24] Due to the vast heterogeneity of devices and liquids used in e-cigarettes, it is generally difficult to identify any specific entity that is linked to all the respiratory cases. Concerningly, increasing poly-use would thus make it more challenging to tease out health effects of nicotine vs non-nicotine substances in e-cigarettes, posing a complex regulatory challenge for the FDA and other regulatory agencies. Additionally, a significant 38% of EVALI patients were 18 to 24 years old.[7] From our analysis, we project that there are approximately 640,000 marijuana vapers (dual and marijuana-predominant) aged 18-24 years of age in the US in 2018, who could be at a greater risk for EVALI compared to other age groups.

Our study has some limitations. All information in BRFSS, including e-cigarette and marijuana use data, was self-reported; biochemical confirmation was unavailable. Additionally, the cross-sectional, observational nature of the analyses would prevent making any causal associations between dual vaping and any sociodemographic factor. We also did not have data on the types of e-cigarette devices used to vape nicotine and marijuana. Also, our analysis focused among adults only. Future research focusing on youth and adolescents must also be a priority. While the 2017 and 2018 BRFSS included an interviewer's note for the e-cigarette questions to reliably capture nicotine use separate from marijuana use, this note was not included in 2016 BRFSS. Thus, some unmeasured non-nicotine use could have been captured. To account for some non-nicotine use, we therefore used the label 'predominant' which we think best captures current use patterns. Additionally, it is challenging to assess impact of state policies on trends in marijuana use. States that have

the same state-level policy e.g. legalized medical marijuana, could still have important regulatory differences between them.[26] In addition, there is a heterogeneity in legislation approaches to marijuana use even among local jurisdictions within states.[27] Thus, continued surveillance and further research, including detailed policy studies, are needed to assess impact of policies within and between states.

Conclusion

Given the limited data on poly-use in e-cigarettes, and the emerging epidemic of acute lung injury observed in such users, it is critical to thoroughly characterize this emerging population. We report that dual nicotine and marijuana vaping among adults using e-cigarettes is common (7.1%), and dual vapers are relatively older and less likely to use traditional cigarettes. Dual vaping is also higher among Blacks and Hispanics compared to nicotine vaping.

Our analysis reports up to date data on nicotine and marijuana vaping, which may be used to inform tobacco regulatory researchers, agencies and public health organizations about the emergence of poly-use in adult e-cigarette vapers, and may help guide future regulatory efforts and public health education campaigns to this potentially vulnerable population.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Declaration of competing interest

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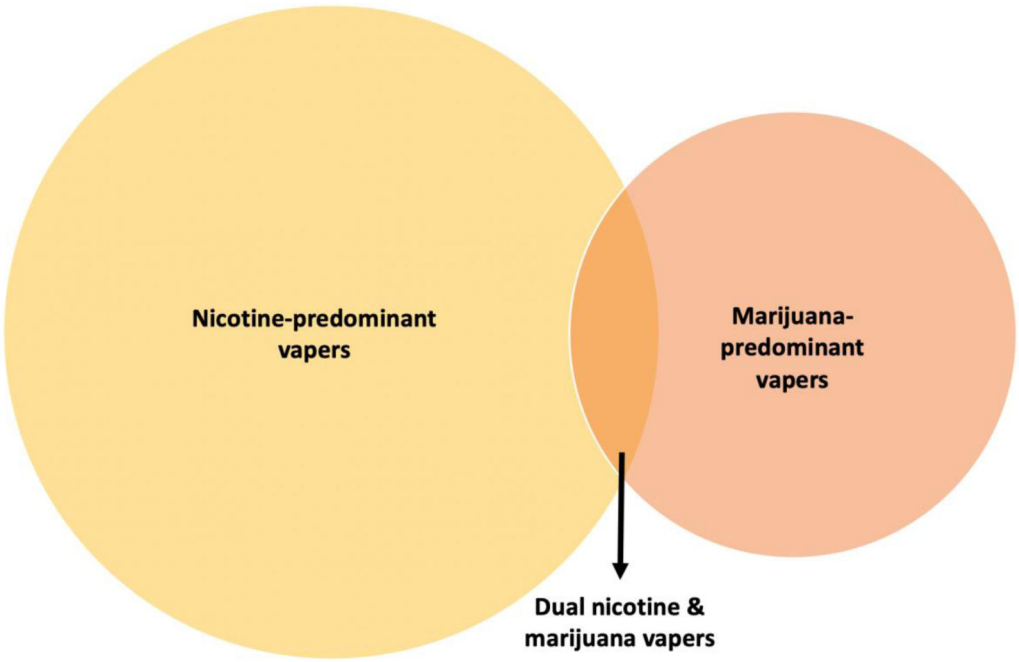

Figure 1.

Schema showing the three sub-populations in the study: nicotine-predominant vapers (gold), dual nicotine and marijuana vapers (orange) and marijuana-predominant vapers (light orange).

Note. Not to scale. Counts and weighted prevalence: Nicotine-predominant vapers, 2904 (3.36%); dual nicotine marijuana vapers 164 (0.38%); Marijuana-predominant vapers 570 (1.09%).

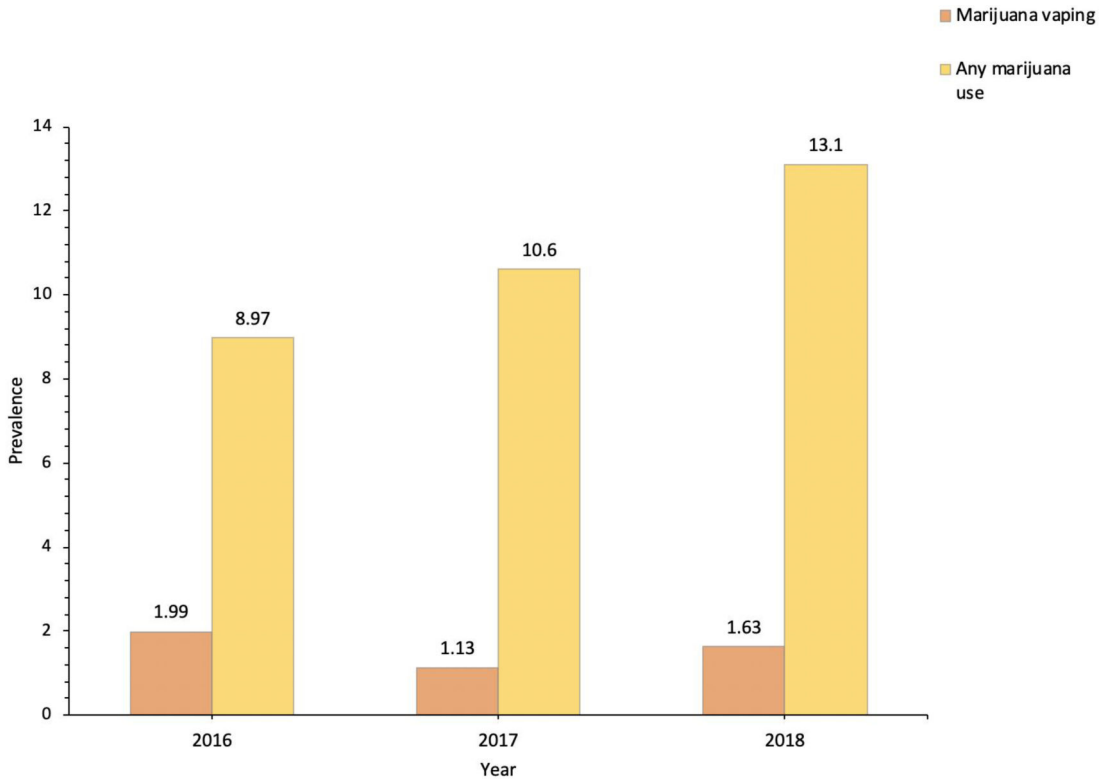

Figure 2.

Trends in prevalence of past-30 day any marijuana use (yellow) and marijuana vaping (orange) from 2016-2018 for the six states that provided marijuana data each year. States: California, Idaho, Minnesota, Oklahoma, Tennessee, Wyoming.

Table 1.

Sociodemographic and health-related characteristics among nicotine-predominant, dual nicotine and marijuana and marijuana-predominant e-cigarette users in the US, 2018

	Nicotine- predominant vaping	**Dual nicotine marijuana vaping**	**Marijuana-predominant vaping**
	(Unweighted n = 2904)	**(Unweighted n =164)**	**(Unweighted n = 570)**
Age, years			
18 to 24	33.2 (29.5-37.2)	17.2 (9.81-28.4)	18.3 (13.0-25.0)
25 to 44	41.2 (37.4-45.0)	59.6 (45.6-72.2)	47.7 (41.1-54.4)
45 to 69	23.7 (21.2-26.3)	19.7 (12.1-30.4)	30.7 (25.0-37.0)
70+	2.0 (1.5-2.7)	3.5 (0.9-12.9)	3.4 (1.9-5.8)
Sex			
Male	58.6 (54.9-62.3)	58.5 (43.4-72.2)	62.1 (55.4-68.4)
Female	41.3 (37.6-45.1)	41.4 (27.7-56.5)	37.9 (31.6-44.6)
Race			
Whites	71.5 (67.1-75.6)	54.0 (38.4-68.9)	55.9 (48.9-62.7)
Blacks	9.4 (6.9-12.8)	14.9 (5.9-32.7)	4.7 (2.5-8.4)
Hispanics	12.7 (9.3-17.2)	27.1 (13.9-46.1)	28.6 (22.3-36.0)
Other groups	6.4 (5.1-7.9)	4.0 (1.5-10.1)	10.8 (7.3-15.8)
Highest education level			
Less than high school diploma	12.7 (10.3-15.5)	10.2 (4.4-21.9)	5.0 (2.4-10.2)
High school diploma	39.6 (35.8-43.4)	16.4 (9.9-25.8)	24.3 (18.4-31.2)
Some college	47.8 (44.0-51.5)	73.4 (60.9 -83.0)	70.8 (63.4-77.1)
Federal Poverty Line Ratio of Household Income			
<1	14.4 (12.1-17.1)	14.1 (7.3-25.5)	10.3 (6.7-15.3)
1-2	26.6 (23.2-30.2)	12.6 (6.7-22.4)	20.2 (15.1-26.4)
>2	59.0 (55.2-62.7)	73.3 (60.4-83.1)	69.6 (62.8-75.6)
Depression	33.4 (30.1-37.0)	34.9 (23.3-48.6)	35.2 (28.8-42.3)
BMI			
Underweight	3.3 (2.2-4.8)	2.3 (0.9-5.4)	3.0 (1.4-6.6)
Normal weight	38.2 (34.6-42.0)	26.1 (16.1-39.6)	38.4 (32.1 -45.2)
Overweight	32.4 (28.8-36.1)	37.4 (24.2-52.8)	30.8 (24.9-37.3)
Obese	26.2 (23.0-29.6)	34.2 (20.6-51.1)	27.8 (21.8-34.7)

	Nicotine- predominant vaping	**Dual nicotine marijuana vaping**	**Marijuana-predominant vaping**
	(Unweighted n = 2904)	**(Unweighted n =164)**	**(Unweighted n = 570)**
Smoking status			
Never smoker	24.0 (20.7-27.6)	32.1 (21.0-45.7)	54.5 (47.8-61.1)
Current smoker	44.7 (41.0-48.4)	23.7 (14.7-35.9)	11.1 (7.9-15.4)
Former smoker	31.4 (28.0-35.0)	44.2 (29.5-60.0)	34.3 (28.3-41.0)

Results presented as % (95% confidence interval)

Table 2:

Association between sociodemographic and health factors, and patterns of vaping.

	Dual vaper (1) vs Nicotine-pred. vaper (0)		**Marijuana-pred. (1) vs Nicotine-pred. vaper (0)**	
	OR (95% CI)	***P*-value**	**OR (95% CI)**	***P*-value**
Age				
18 to 24	Ref		Ref	
25 to 44	3.44 (1.74-6.84)	0.000	4.76 (1.75-12.9	0.002
45 to 69	2.74 (1.12-6.67)	0.027	5.23 (1.84-14.9	0.002
70+	7.31(1.65-32.5)	0.009	14.5 (3.74-55.9	0.000
Sex				
Female	Ref		Ref	
Male	0.96 (0.50-1.84)	0.912	1.87 (1.19-2.93)	0.006
Race				
Whites	Ref		Ref	
Blacks	1.74 (0.62-4.91)	0.296	1.00 (0.40-2.52	0.998
Hispanics	3.10 (1.18-8.13)	0.021	1.94 (0.48-7.93	0.354
Other groups	0.88 (0.30-2.58)	0.811	0.55 (0.22-1.39	0.206
Education				
Less than high school diploma	Ref		Ref	
High school diploma	0.46 (0.14-1.49)	0.195	0.45 (0.11-1.82	0.265
Some college	1.40 (0.44-4.38)	0.567	0.94 (0.29-3.02	0.912
Federal Poverty Line Ratio of Household Income				
<1	Ref		Ref	
"1-2"	0.31 (0.13-0.74)	0.009	2.26 (0.95-5.36	0.064
>2	1.03 (0.45-2.34)	0.948	2.37 (1.17-4.82	0.017
Depression	1.22 (0.69-2.17)	0.494	1.85 (1.06-3.23	0.031
BMI				
Underweight	Ref		Ref	
Normal weight	0.51 (0.16-1.68)	0.271	1.26 (0.31-5.22	0.747
Overweight	0.78 (0.24-2.60)	0.691	0.78 (0.20-3.09	0.727
Obese	0.79 (0.24-2.63)	0.705	1.37 (0.32-5.85	0.672

	Dual vaper (1) vs Nicotine-pred. vaper (0)		**Marijuana-pred. (1) vs Nicotine-pred. vaper (0)**	
	OR (95% CI)	***P*-value**	**OR (95% CI)**	***P*-value**
Smoking status				
Current smoker	Ref		Ref	
Never smoker	3.77 (1.70-8.38)	0.001	17.7 (8.38-37.5)	0.000
Former smoker	2.54 (1.23-5.27)	0.012	3.35 (1.67-6.73)	0.001

OR = odds ratio, CI = confidence interval, Pred. = Predominant

All models were adjusted for: age, sex, race, education, poverty level, clinical depression, BMI and smoking status.

Table 3.

Prevalence (95% confidence interval) of past 30-day marijuana vaping (dual and marijuana-predominant) among different sociodemographic groups in the US, 2018

	Marijuana vaping
Age, y	
18 to 24	2.1 (1.5-2.9)
25 to 44	2.0 (1.7-2.4)
45 to 69	0.9 (0.7-1.1)
70+	0.3 (0.2-0.5)
	.
Sex	
Male	1.7 (1.4-2.0)
Female	1.0 (0.8-1.2)
	.
Race	
Whites	1.2 (1.1-1.5)
Blacks	0.8 (0.5-1.3)
Hispanics	1.6 (1.2-2.1)
Other groups	1.4 (0.9-2.0)
	.
Highest education level	
Less than high school diploma	0.5 (0.3-0.9)
High school diploma	1.1 (0.8-1.5)
Some college	1.6 (1.4-1.8)
	.
Federal Poverty Line Ratio of Household Income	
<1	0.9 (0.6-1.3)
1-2	1.2 (0.9-1.6)
>2	1.4 (1.2-1.6)
	.
Depression	
	2.5 (2.0-3.1)
	.
BMI	
Underweight	2.3 (1.1-4.5)
Normal weight	1.5 (1.3-1.9)
Overweight	1.2 (1.0-1.5)
Obese	1.3 (1.0-1.6)
	.
Smoking status	

	Marijuana vaping
Never smoker	1.1 (0.9-1.3)
Current smoker	1.2 (0.9-1.5)
Former smoker	1.9 (1.5-2.3)