



# Self-reported changes in cannabis vaping among US adolescents and young adults early in the COVID-19 pandemic

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## ABSTRACT

Cannabis vaping may increase susceptibility to COVID-19 infection and related outcomes; however, little is known about the impact of the pandemic on cannabis vaping among US young populations. This study examined self-reported changes in cannabis vaping since the pandemic and factors associated with changes. A national, cross-sectional survey was conducted among 4,351 US adolescents and young adults (13–24 years old) in May 2020. Of those, 1,553 participants who reported ever vaping cannabis were included in the analytic sample. Binary outcome was self-reported increase in cannabis vaping (more hours/times of vaping in a day) vs. no change/quitting/reducing/switching. Weighted logistic regression examined associations between independent variables (i.e., risk perceptions of vaping, cannabis dependence, and stress/anxiety) and the outcome, controlling for sociodemographic factors. Overall, 6.8% reported increasing cannabis vaping since the pandemic, 37.0% quitting or reducing vaping in general, and 42.3% no change. Participants were more likely to report increased cannabis vaping if they perceived “Vaping is safer than smoking cigarettes” (Adjusted Odds Ratio [AOR] = 3.66; 95%CI = 1.43–9.38), reported more dependence on cannabis vaping (AOR = 1.59; 95%CI = 1.11–2.27), and were female (AOR = 2.80; 95%CI = 1.23–6.36). Those perceiving “Vaping cannabis can cause lung injuries” were less likely to increase cannabis vaping (AOR = 0.37; 95%CI = 0.18–0.76). Findings indicate that adolescent and young adult ever-cannabis vapers were more likely to report decreasing vaping generally than increasing cannabis vaping and most did not change use during the early pandemic. Educational campaigns should address potential health risks of cannabis vaping and focus on lung health to reduce use among young people during and following the pandemic.

## 1. Introduction

Cannabis (marijuana) vaping among US adolescents and young adults is an increasing public health concern (Miech et al., 2020; Palamar, 2021). Recent data show prevalence of past 30-day cannabis vaping is 4% among 8th graders, 14% among 12th graders, and 17% among young adults (Miech et al., 2020). Vaping cannabis or specifically tetrahydrocannabinol (THC - the main psychoactive compound in cannabis) is associated with lung harms (e.g., the outbreak of e-cigarette or vaping-related lung injury or EVALI) and increased susceptibility to COVID-19 infection and related outcomes (Borgonhi et al., 2021; Boyd et al., 2021; King et al., 2020; Volkow, 2020). In addition, youth sharing and borrowing vaping devices may also facilitate COVID-19 transmission (Dumas et al., 2020). Given the vulnerability to vaping-related lung diseases, addressing cannabis vaping among adolescents and young

adults during the pandemic is imperative. While studies have examined changes in tobacco vaping in this population (e.g., Chaffee et al., 2021; Gaiha et al., 2020; Kreslake et al., 2021), little is known about whether and why adolescents and young adults changed their cannabis vaping during the COVID-19 pandemic. A few studies have examined changes in cannabis use generally during the pandemic. One study found that overall prevalence of cannabis use did not decline after stay-at-home orders in a cohort of adolescents in California (Chaffee et al., 2021). Another study found that the prevalence of cannabis use declined for girls only, but the frequency of cannabis use (average number of days used) increased from pre- to post-pandemic in a sample of Canadian adolescents (Dumas et al., 2020). These studies, however, did not specifically examine changes in cannabis vaping during the pandemic. More data are needed for continued surveillance and prevention on cannabis use, especially via vaporized devices.

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To address this gap, we examined self-reported changes in cannabis vaping during the early stage of the pandemic among 1,553 adolescents and young adults who reported ever vaping cannabis. We also examined factors associated with any increased cannabis vaping, in order to identify those who might most benefit from education and prevention efforts. Based on the existing literature related to cannabis vaping (Miech et al., 2020; Morean et al., 2017), we examined a variety of well-documented risk factors for adolescent and young adult cannabis vaping, including risk perceptions of vaping, cannabis vaping dependence, feeling stress or anxiety, and sociodemographic characteristics.

## 2. Methods

### 2.1. Design and Participants

This study used data from a national, cross-sectional, online survey of adolescents and young adults (13–24 years old) conducted in May 2020 (Gaiha et al., 2020). Participants were recruited from Qualtrics' online panels. As the focus of the survey was on vaping, we purposely recruited half of the sample who endorsed having "ever used an e-cigarette or vape before today." We also used sampling quotas to balance ratios for age groups and to match the latest U.S. census for ratios of sex and racial/ethnic groups. Participants provided online consent and assent before beginning the self-administered survey. The online survey took approximately 15–20 minutes to complete. Respondents who completed the survey in less than one-third of the average completion time were removed from the study. As such, we excluded 269 surveys that did not meet quality checks. The survey was approved by Stanford University's Institutional Review Board and met the institution's guidelines for protection of human subjects concerning their safety and privacy. Among 4,351 people who completed the survey, the 1,553 participants who reported ever vaping cannabis were included in the analytic sample.

### 2.2. Measures

All survey items were developed and pilot tested with our Youth Advisory Board. The survey items specific to this paper are described below.

#### 2.2.1. Demographics

Age, sex (male, female), gender (heterosexual, LGBTQ+), race/ethnicity, and mother's education were self-reported. Age was categorized into 2 groups: adolescents (13–17 years old) and young adults (18–24 years old).

#### 2.2.2. Changes in cannabis vaping

Participants were asked, "Since the start of the COVID-19 pandemic in the US, have you changed the amount you vape (times or hours of vaping in a day)?" followed by "Which of the following best describes the change in vaping?" Answer options included "Increased the amount I vape marijuana/THC (more hours or more times in a day)," "Increased the amount I vape nicotine," "Quit using vapes altogether," "Reduced slightly," "Reduced the amount I vape by half," "Switched from vaping marijuana to other forms of marijuana," and "Switched from vaping nicotine to other forms of nicotine." Participants were asked to select only 1 option that best reflected their changes in vaping behavior, if any. Since the options of vaping reduction did not specify whether participants reduced nicotine or cannabis, we could not distinguish whether participants decreased cannabis vaping or decreased nicotine vaping or both. Thus, in this study we focused on changes in cannabis vaping as a binary outcome, where self-reports of increased amount of vaping cannabis were coded as 1 and self-reports of the remaining options were coded as 0.

### 2.2.3. Cannabis-related variables

*Use of other cannabis products* was measured as any use of combustible cannabis, edible cannabis, or blunts during the past 30 days.

*Dependence on cannabis vaping* was measured as time elapsed after waking up when a participant first vaped cannabis (within 5 minutes, 6 to 30 minutes, 31–60 minutes, and after 60 minutes). Shorter time indicates more dependence on cannabis vaping (Heatherton et al., 1991).

*Risk perceptions of vaping* were measured as participants' agreement on each of these statements: "Young people are at risk of respiratory problems due to vaping," "Vaping increases the risk of COVID-19 because it affects the lungs," "Vaping is safer than smoking cigarettes," "Vaping cannabis can cause lung injuries," and "Daily cannabis vaping is harmful to health." Responses were on a 4-point Likert scale (from Strongly Agree to Strongly Disagree) and dichotomized (Agree vs. Disagree).

### 2.2.4. Stress/Anxiety

Participants were asked, "Since the COVID-19 pandemic I am stressed or anxious..." Answer options included "Not at all," "Several days," "More than half of the days," and "Nearly every day."

## 2.3. Statistical analysis

All analyses were weighted to adjust for the sampling design and clustering within state, using STATA 15.0. Proportions of cannabis-related factors, stress/anxiety, and sociodemographic characteristics were calculated with missing responses included in denominators. Logistic regressions examined the associations between regressors (risk perceptions, dependence, and stress/anxiety) and the binary outcome (self-reported increase in cannabis vaping vs. no increase), controlling for covariates (age, sex, gender, race/ethnicity, and mother's education). All tests were two-tailed with a significance level of  $\alpha < 0.05$ .

## 3. Results

### 3.1. Sample characteristics

Sample mean age was 19.4 years (SD = 2.6) with 69.0% young adults (18–24 years old) and 24.7% identifying as LGBTQ+ (Table 1). The majority were female (68.9%), non-Hispanic White (39.0%), reported mother's education of college or higher (64.1%), and reported experiencing any stress/anxiety since the pandemic (80.4%).

### 3.2. Change in cannabis vaping and other cannabis-related factors

Most participants (42.3%) who had ever vaped cannabis reported no change in their vaping (of any substance) since the pandemic, 18.7% reported quitting, 18.3% reported reducing their vaping of cannabis and/or nicotine, and 6.8% reported increasing their cannabis vaping (Table 1). Participants who ever vaped cannabis also reported using cannabis in other forms in the past 30 days, including combustible cannabis (50.8%), blunts (39.6%), and edible cannabis (33.8%). Regarding dependence on cannabis vaping, 32.2% reported vaping cannabis within 60 minutes of waking up. Table 1 also shows that agreement with risk perceptions of vaping varied, with 55.5% perceiving "Vaping is safer than smoking cigarettes" and 65.2% perceiving "Vaping cannabis can cause lung injuries."

### 3.3. Factors associated with increased cannabis vaping

Participants were more likely to self-report increased cannabis vaping if they perceived vaping as safer than smoking cigarettes (Adjusted Odds Ratio [AOR] = 3.66; 95%CI = 1.43–9.38), reported more dependence on cannabis vaping (AOR = 1.59; 95%CI = 1.11–2.27), and were female (AOR = 2.80; 95%CI = 1.23–6.36) (Table 2). Those perceiving that vaping cannabis can cause lung injuries were less likely to report an

**Table 1**  
Characteristics of the study sample (N = 1,553 ever cannabis vapers in US).

Variables	Weighted % (95% CI)
<b>Sociodemographic characteristics</b>	
Age	
13–17 years old	30.6 (26.1–35.5)
18–24 years old	69.0 (64.1–73.5)
Gender	
Male	29.4 (24.5–34.8)
Female	68.9 (63.1–74.1)
Other	1.7 (1.0–2.9)
Sexual identity	
Heterosexual	75.3 (70.2–79.7)
LGBTQ+	24.7 (20.3–29.8)
Race/ethnicity	
Non-Hispanic White	39.0 (31.9–46.7)
Non-Hispanic Black	18.8 (14.7–23.6)
Hispanic	26.2 (20.5–32.8)
Non-Hispanic API	7.7 (5.3–11.1)
Non-Hispanic Other	8.3 (6.6–10.5)
Mother's education	
High school or below	26.5 (21.7–32.0)
Attended or completed college	45.3 (41.7–49.0)
Graduate or professional degree	18.8 (15.6–22.6)
Don't know	9.0 (6.6–12.1)
<b>Feeling stressed or anxious since the pandemic</b>	
Not at all	19.5 (15.8–23.7)
Several days	35.6 (31.0–40.4)
Half of the days	23.5 (20.2–27.1)
Everyday	21.3 (17.8–25.4)
<b>Change in vaping amount since the pandemic</b>	
Increase vaping cannabis	6.8 (4.5–10.2)
Quit vaping cannabis and nicotine altogether	18.7 (14.7–23.5)
Reduce the vaping amount by half	10.1 (7.2–14.0)
Reduce the vaping amount slightly	8.2 (6.3–10.6)
Switch from vaping cannabis to other cannabis products	2.8 (1.6–4.9)
Increase vaping nicotine	8.5 (6.6–11.0)
Switch from vaping nicotine to other nicotine products	2.3 (1.5–3.6)
No change	42.3 (36.8–48.1)
<b>Past 30-day use of other cannabis products</b>	
Combustible cannabis	50.8 (46.0–55.6)
Edible cannabis	33.8 (29.5–38.3)
Blunts	39.6 (35.1–44.3)
<b>Dependence on cannabis vaping</b> (“How soon after waking up did you vape cannabis?”)	
Within 5 minutes	9.7 (7.2–12.9)
6–30 minutes	14.0 (11.2–17.4)
31–60 minutes	8.5 (6.9–10.4)
More than 60 minutes	57.6 (52.4–62.7)
<b>Risk perceptions of vaping</b> (Agreement with each statement)	
Young people are at risk of respiratory problems due to vaping	81.1 (77.7–84.1)
Vaping increases the risk of COVID-19	63.4 (58.1–68.5)
Vaping is safer than smoking cigarettes	55.5 (51.2–59.7)
Vaping cannabis can cause lung injuries	65.2 (59.2–70.7)
Daily vaping of cannabis is harmful to health	74.9 (70.1–79.2)

Note: LGBTQ+: Lesbian, gay, bisexual, transgender, queer, and other.

increase (AOR = 0.37; 95%CI = 0.18–0.76).

#### 4. Discussion

This study examined changes in cannabis vaping among US adolescents and young adults early in the COVID-19 pandemic. Our finding that more participants who ever vaped cannabis reported reducing or quitting vaping generally than increasing cannabis vaping is consistent with prior research on the pandemic's impact on vaping and/or e-cigarette use in this population (Chaffee et al., 2021; Dumas et al., 2020; Gaiha et al., 2020; Kreslake et al., 2021; Sokolovsky et al., 2021; Tattan-Birch et al., 2021). A reduction in cannabis vaping during the pandemic could be due to concerns of susceptibility to COVID-19, disruptions in access to cannabis products, or fewer social engagements with peers (Berg et al., 2020; Dumas et al., 2020; Kreslake et al., 2021; Tattan-Birch et al., 2021). However, not all young people were deterred from vaping

**Table 2**  
Factors associated with increased cannabis vaping early in the COVID-19 pandemic among US adolescents and young adults who ever vaped cannabis (N = 1553).

Variables	Adjusted OR (95% CI)
<b>Risk perceptions (Agree vs. Disagree)</b>	
Young people are at risk of respiratory problems due to vaping	1.85 (0.77–4.45)
Vaping increases the risk of COVID-19	1.46 (0.57–3.78)
Vaping is safer than smoking cigarettes	<b>3.66 (1.43–9.38)**</b>
Vaping cannabis can cause lung injuries	<b>0.37 (0.18–0.76)**</b>
Daily vaping of cannabis is harmful to health	1.31 (0.54–3.16)
<b>Dependence on cannabis vaping (Yes vs. No)</b>	
Past 30-day use of other cannabis modes (Yes vs. No)	<b>1.59 (1.11–2.27)*</b>
<b>Past 30-day use of other cannabis modes (Yes vs. No)</b>	
Combustible cannabis	2.06 (0.42–10.09)
Edible cannabis	2.31 (0.70–7.69)
Blunts	2.24 (0.54–9.29)
<b>Feeling stressed or anxious since the pandemic</b>	
Not at all	1.00 [Reference]
Several days	1.04 (0.18–6.07)
More than half of the days	1.78 (0.40–7.96)
Nearly every day	1.83 (0.39–8.49)
<b>Sociodemographic characteristics</b>	
Age	
13–17 years old vs. 18–24 years old	2.46 (0.95–6.38)
Gender	
Male	1.00 [Reference]
Female	<b>2.80 (1.23–6.36)*</b>
Other	0.32 (0.02–5.36)
LGBTQ+ vs. Heterosexuals	1.49 (0.53–4.18)
Race/ethnicity	
Non-Hispanic White	1.00 [Reference]
Non-Hispanic Black	0.48 (0.14–1.58)
Hispanic	1.66 (0.75–3.65)
Non-Hispanic API	0.67 (0.20–2.23)
Non-Hispanic Other	0.64 (0.18–2.23)
Mother's education	
High school or below	1.00 [Reference]
Attended or completed college	1.70 (0.89–3.24)
Graduate or professional degree	1.76 (0.54–5.72)
Don't know	0.49 (0.06–4.21)

Note: Boldface indicates statistical significance (\*p < 0.05, \*\*p < 0.01).

cannabis since most ever-cannabis vapers reported no change and a subgroup reported an increase. This highlights a need to prevent cannabis vaping among all adolescents and young adults, particularly among those who are dependent on cannabis vaping. The findings also suggest that females might need more support, but we cannot determine why females are more likely to increase use than males.

Our study also found associations between risk perceptions and cannabis vaping among adolescents and young adults during the pandemic. That young people perceive vaping cannabis as less harmful than other forms of substance use (e.g., smoking cannabis or tobacco) (Roditis & Halpern-Felsher, 2015) is consistent with our finding that the perception of vaping as safer than cigarette smoking was associated with higher odds of increased cannabis vaping. Conversely, the perception that vaping cannabis can cause lung injuries was associated with lower odds of increased cannabis vaping during the pandemic.

Our study has several limitations. The cross-sectional design is unable to establish a causal relationship between changes in cannabis vaping and associated factors. In addition, self-reported data may be subject to recall bias. Our convenience sampling may also limit the findings' generalizability. The measure assessing a decrease in vaping did not allow us to distinguish cannabis vaping from nicotine vaping; thus, we could not examine factors associated with decreased cannabis vaping per se in this study.

Collectively, the current COVID-19 pandemic provides a timely opportunity for educational interventions to curb cannabis vaping among young populations. Perceived low health risk is associated with the popularity of cannabis vaping, yet much remains unknown about health

effects of vaporized cannabis (Miech et al., 2021). There is even less evidence on the intersection of youth vaping and COVID-19. However, recent studies indicated that unsubstantiated health claims and inaccurate information on social media about possible protective effects of cannabis vaping may influence cannabis vaping behavior (Janmohamed et al., 2020). Prevention efforts should highlight that vaping cannabis can cause lung injuries and correct misperceptions that vaping is safer than smoking to increase young people's awareness of potential risks related to cannabis vaping. Given that early intervention can prevent escalation of cannabis vaping and long-term addiction (Budney et al., 2015) and that prevention and cessation programs are associated with reduced intent or actual use of e-cigarettes (e.g., Gaiha & Halpern-Felsher, 2021), programs to prevent cannabis vaping should be developed and offered to young people. Prevention and cessation interventions may be tailored to specifically target more dependent vapers since this group was more likely to increase their cannabis vaping during the pandemic. Continued surveillance is also needed to understand how adolescents and young adults change their vaping in response to the evolving status of the pandemic (e.g., reopening of schools, availability of COVID-19 vaccines).

## 5. Conclusions

Adolescents and young adults who ever vaped cannabis were more likely to report decreasing than increasing use and most did not change use during the early pandemic. Educational campaigns should highlight potential lung injuries related to cannabis vaping to prevent increased use and promote well-being among adolescents and young adults during and following the pandemic.

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## CRedit authorship contribution statement

**Nhung Nguyen:** Conceptualization, Data curation, Formal analysis, Writing – original draft. **Shivani Mathur Gaiha:** Data curation, Investigation, Methodology, Project administration, Writing – review & editing. **Bonnie Halpern-Felsher:** Funding acquisition, Investigation, Project administration, Supervision, Writing – review & editing.

## 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.

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