

Perceived impacts of the COVID-19 pandemic on cannabis-using emerging adults

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Abstract

Cannabis-using youth are a large epidemiologic subgroup whose age and smoking-related risks underscore the importance of examining the impact of the COVID-19 pandemic in this population. Within a clinical trial ($n = 36$ received an intervention prior to data collection reported herein), we surveyed cannabis-using emerging adults (ages 18–25) about perceived COVID-19 impacts. Participants ($n = 141$) reporting weekly cannabis use ($M = 18.6$ use days in the past 30) were enrolled and completed online surveys as part of either their baseline or 3 month assessment. COVID-19-related measures included symptoms, substance use, mood, etc. Participants were 57% female (mean age = 21, standard deviation = 2.2), with 21% Hispanic/Latinx, 70% White, 20% Black/African American, and 10% of other races. Most participants (86%) reported quarantine/self-isolation ($M = 59$ days). Several had COVID-19 symptoms (16%), but none reported testing COVID-19 positive. Many respondents felt their cannabis use (35%–50%, across consumption methods) and negative emotions (e.g., loneliness, stress, and depression; 69.5%, 69.5%, and 61.8%, respectively) increased. They reported decreased in-person socialization (90.8%) and job losses (23.4%). Reports of increased cannabis smoking were associated with increased negative emotions. On an open-response item, employment/finances and social isolation were frequently named negative impacts (33.3% and 29.4%, respectively). Although cannabis-using emerging adults' reports of increases in cannabis use, coupled with mental health symptoms and social isolation, are concerning, the full impact of the pandemic on their health and well-being remains unknown. Future studies examining the relationship between social isolation, mental health, and cannabis use among young people are needed.

Keywords

Emerging adults, Cannabis, Coronavirus pandemic

INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has had wide-ranging impacts on society, particularly among vulnerable populations. People who misuse substances may be particularly susceptible to social isolation and other pandemic-related hardships [1]. A recent U.S. report found that 13% of adults started or increased substance use to cope with COVID-19 [2]. The stress of the pandemic, combined with the social isolation resulting from essential public health strategies to contain transmission, may contribute to worsening mental health and/or increased substance

Implications

Practice: Substance use, mental health, and physical health practitioners should know that, during COVID-19, young people who use cannabis may be especially vulnerable to negative psychosocial impacts of the pandemic; they should assess for these issues and refer for supportive interventions where possible.

Policy: Policy makers should be aware of the increases in cannabis use among youth during this pandemic and consider policy revisions that can help protect the health of these youth during a time of great stress and vulnerability.

Research: Future research is needed to fully understand how cannabis use changes during this ongoing pandemic and the implications for health and well-being, particularly among vulnerable populations who are already engaged in this risky behavior and experiencing significant mental health concerns.

misuse [3–6]. Prior work has identified links between social isolation (e.g., loneliness) and these outcomes [7–10]. Increased negative emotions due to the pandemic are also likely [5, 11], which could increase coping-related substance use motives that precipitate use [6].

Other than alcohol and tobacco, cannabis is the most commonly consumed drug in the U.S., with prevalence typically highest among emerging adults (ages 18–25), who may be especially impacted by social isolation [12–14]. Given that smoking is a primary method of cannabis consumption, individuals who consume cannabis may also have higher risk for respiratory and pulmonary complications of COVID-19 infection [6, 15, 16]. To date, studies examining smoking and COVID-19 have focused on tobacco rather than cannabis [17–19].

It remains crucial to examine the association between substance use and other related behaviors among broad samples of cannabis-using emerging adults during this pandemic, with most research to

date focusing solely on college students or other age groups [20–22]. For example, in a survey of college students, both binge drinking and illicit drug use (not otherwise specified) declined after COVID-19 onset [22]. Another study of university students (including ages up to 60 years) in Russia and Belarus found that one-fifth to one-third reported pandemic-related increases in tobacco, alcohol, cannabis, and other drugs [23]. Among Canadian adolescents (ages 14–18), recent 3 week prevalence of binge drinking, cannabis use, and vaping (presumably nicotine, as this was measured separately from cannabis use) were lower compared to the 3 weeks prior to the pandemic, with increases in mean alcohol and cannabis use days [24].

Importantly, findings for pandemic-related changes in substance use may differ among higher risk samples engaging in regular substance use or misuse. Therefore, to contribute to the nascent literature on COVID-19 among vulnerable substance-using populations of youth, we examined self-reported perceptions of changes in cannabis and alcohol use and other psychosocial outcomes, among emerging adults who regularly use cannabis. We collected data as part of an ongoing cannabis intervention study initiated just before the COVID-19 pandemic hit the U.S. Given the limited prior literature, we had no *a priori* hypotheses and rather sought to provide a descriptive exploration to inform future research and prevention services. Note that we examine perceptions of behaviors before/during the pandemic and do not examine outcomes relative to the pilot randomized controlled trial (RCT) as follow-ups are ongoing.

METHODS

Overall study procedures

The present data were collected within an ongoing pilot RCT of an online cannabis intervention for emerging adults; all procedures occurred online. We recruited participants using social media ads that led to an online consent and screening survey to determine RCT eligibility (i.e., ages 18–25, past-month cannabis use with tetrahydrocannabinol (THC) 3+ times per week). Advertisements included photos and headlines, such as: “Use weed? Participate in a research study, earn \$\$\$\$. See if you’re eligible, click here!” and participants were recruited regardless of their intentions to change cannabis use. The RCT involves group-based intervention and control conditions conducted separately by age (18–20 and 21–25 years) and residence (states with/without legal recreational cannabis); eligibility criteria were the same regardless of state residence. Recruitment procedures paralleled prior work [25] and took place in two waves. Wave 1 (participants in states without legal recreational cannabis) was recruited in February 2020 prior to full emergence

of COVID-19 in the U.S. Wave 2 recruitment occurred in May 2020 (participants in states with legal recreational cannabis). This study was approved by our institutional review board and we received a standard Certificate of Confidentiality from the National Institutes of Health.

After online eligibility screening, baseline invitation, and completing enrollment procedures, including identity verification, our sample included $N = 149$ randomized to conditions (Wave 1 intervention $n = 38$; control $n = 35$; Wave 2 intervention $n = 38$, control $n = 38$). Participants received electronic gift cards (\$35 value) at each assessment described herein.

Procedures in response to COVID-19

Given the rapid onset of COVID-19 in March 2020 (e.g., stay-at-home orders, community spread, and school closures), we added assessments pertaining to COVID-19 at the baseline survey for Wave 2 ($n = 76$ in May 2020) and at the 3 month follow-up for Wave 1 participants ($n = 65$ completing follow-up in June 2020; $n = 36$ had received the intervention, the remaining were in the control group). We elected to combine these data resulting in an analytic sample of $n = 141$ in this time-sensitive analysis after conducting preliminary chi-square and *t*-tests to confirm that the cohorts did not significantly differ on most demographics and cannabis use indicators (see Tables 1 and 2 for results). Cohorts also did not differ on key indicators of COVID-19-related cannabis use (i.e., self-reported COVID-19-related changes in frequency of smoking, vaping, dabbing, or eating cannabis, all $ps > .05$).

Study conditions

As the pilot RCT is ongoing, we cannot examine outcomes. Currently, we focus on data related to COVID-19 only; nonetheless, we provide a brief description of the study conditions for context. Participants in each wave were randomized to either an 8 week intervention or control group, separated by age group. The 8 week intervention occurred in secret private groups on Facebook, moderated by health coaches who posted content for 56 days straight (for the present paper, $n = 36$ had received the intervention prior to data collection for key variables reported herein). Content addressed cannabis use directly as well as upstream motives for cannabis use and prevention of related consequences using a motivational interviewing (MI) style where participants and coaches interacted. Consistent with MI, participants were informed that any changes they might consider making to cannabis use or other health behaviors would be completely up to them. The control group was parallel in length and format, except coaches posted entertaining social media content unrelated to substance use or mental health.

Table 1 | Sample demographics for total sample and by intervention status

	Total sample <i>M (SD)</i> or % (<i>n</i>) <i>n</i> = 141	Nonintervention sample <i>M (SD)</i> or % (<i>n</i>) <i>n</i> = 105	Intervention recipients <i>M (SD)</i> or % (<i>n</i>) <i>n</i> = 36	<i>p</i> -value
Age	21.1 (2.2)	21.0 (2.2)	21.3 (2.4)	.495
Sex				
Male	43.3% (61)	46.7% (49)	33.3% (12)	.164
Female	56.7% (80)	53.3% (56)	66.7% (24)	
Hispanic or Latinx ethnicity	21.3% (30)	23.8% (25)	13.9% (5)	.209
Race				.607
White	70.2% (99)	69.5% (73)	77.8% (28)	
Black/African American	19.9% (28)	21.0% (22)	16.7% (6)	
Other	9.9% (14)	9.5% (10)	5.6% (2)	
Highest education				.002
Completed high school/GED or less	22.0% (31)	15.2% (16)	41.7% (15)	
Some college/technical school/ associate's degree	58.8% (83)	61.9% (65)	50.0% (18)	
Bachelor's degree or higher	19.2% (27)	22.9% (24)	8.3% (3)	
Occupational status				.358
Not working	46.1% (65)	49.5% (52)	36.1% (13)	
Full time work (30+ hrs/week)	27.0% (38)	24.7% (26)	33.3% (12)	
Part time work (<30 hrs/week)	21.3% (30)	21.9% (23)	19.4% (7)	
On disability	1.4% (2)	0.9% (1)	2.7% (1)	
Other (e.g., paid internship, self-employed)	4.3% (6)	2.8% (3)	8.3% (3)	
Living situation				.118
Family	45.4% (64)	52 (49.5%)	12 (33.3%)	
Friend(s)/roommates(s)	23.4% (33)	26 (24.8%)	7 (19.4%)	
Spouse/partner	20.6% (29)	18 (17.1%)	11 (30.6%)	
Alone	10.6% (15)	9 (8.6%)	6 (16.7%)	

For Wave 1, age, sex, race, and ethnicity were assessed at screening, while the remaining items were assessed at the 3 month follow-up when questions about COVID-19 were asked. For Wave 2, all items were completed at screening/baseline.

Measures

Because assessment items were repeated at follow-ups, with the exception of age, sex, race, and ethnicity (recorded at screening), we used participants' most recent responses relative to the onset of the COVID-19 pandemic (Wave 1: 3 month follow-up; Wave 2: baseline) for all measures described herein. This allows us to characterize cannabis use and other variables at the time of the assessment of COVID-19-related questions measured proximal to the pandemic.

Demographics and eligibility

Demographics were assessed with items from prior research [26–29]. Cannabis-related eligibility relied on a single-item measuring frequency of past-month use of cannabis products containing THC based on prior work [30].

COVID-19 assessment

COVID-19 items were designed to assess the prevalence of COVID-19 and perceived impacts. We modified available items to assess whether participants experienced COVID-19 symptoms (e.g., fever,

cough, and shortness of breath), contacted a health care provider due to symptoms, and if they engaged in pandemic-related quarantine or isolation [31]. We developed items to assess the following: COVID-19 hospitalization, known infections in participants' households and social networks, changes in employment status, lost childcare and school closures, and dates of quarantine/social isolation (used to calculate total days in isolation). Among those reporting isolation, we asked about their cannabis use during isolation compared to their usual use of cannabis in the 3 months before the pandemic affected their geographic area (e.g., five-point scale: a lot more than usual to a lot less than usual).

We asked participants about their emotions and behaviors in the 30 days before the pandemic came to their area relative to the past 30 days (response options: increased a lot, increased somewhat, stayed about the same, decreased somewhat, and decreased a lot). Emotions assessed included feeling: lonely, stressed, anxious, depressed, hopeful, and happy. Among those who endorsed each of the following in the past year, we queried changes in: cannabis smoking, vaporizing, dabbing, and eating; using

Table 2 | Descriptive data regarding participants' cannabis and alcohol use for total sample and by intervention status

	Total sample <i>M (SD)</i> or % (<i>n</i>) <i>n</i> = 141	Nonintervention sample <i>M (SD)</i> or % (<i>n</i>) <i>n</i> = 105	Intervention recipients <i>M (SD)</i> or % (<i>n</i>) <i>n</i> = 36	<i>p</i> -value
Past 30 day cannabis use	96.5% (136)	97.1% (102)	94.4% (34)	.450
Total past 30 day cannabis use days	18.6 (10.7)	18.9 (10.7)	17.6(10.8)	.544
Has a medical cannabis certification	22.7% (32)	23.8% (25)	19.4% (7)	.590
Past 30 day cannabis use methods (check all that apply)				
Smoked	88.7% (125)	86.7% (91)	94.4% (34)	.204
Vaporized	67.4% (95)	69.5% (73)	61.1% (22)	.353
Ate	50.4% (71)	53.3% (56)	41.7% (15)	.227
Dabbed	46.1% (65)	44.8% (47)	50.0% (18)	.586
Drank	16.3% (23)	18.1% (19)	11.1% (4)	.328
Applied to skin	13.5% (19)	13.3% (14)	13.9% (5)	.933
Past 30 day sources of cannabis (check all that apply)				
Friend/family	53.1% (75)	52.3% (55)	55.5% (20)	.742
A dealer I know	34.7% (49)	29.5% (31)	50.0% (18)	.026
A recreational dispensary	34.0% (48)	42.8% (45)	8.3% (3)	<.001
A medical dispensary	24.8% (35)	28.5% (30)	13.8% (5)	.078
Someone I know (not friend/family)	17.0% (24)	16.1% (17)	19.4% (7)	.654
A person I do not know (e.g., dealer I haven't met before/ stranger)	6.3% (9)	5.7% (6)	8.3% (3)	.579
Online	3.5% (5)	2.8% (3)	5.5% (2)	.450
A designated caregiver	2.1% (3)	2.8% (3)	0 (0.0%)	.305
Grew it myself	1.4% (2)	1.9% (2)	0 (0.0%)	.404
Other	1.4% (2)	0.0% (0)	5.5% (2)	.015
Did not obtain cannabis in the past month	7.0% (10)	7.6% (8)	5.5% (2)	.677
Average hours high per day ^a				.533
≤2 hr	21.3% (29)	21.6% (22)	20.6% (7)	
3–4 hr	34.6% (47)	34.3% (35)	35.3% (12)	
5–6 hr	22.1% (30)	20.6% (21)	26.5% (9)	
7–8 hr	9.6% (13)	9.8% (10)	8.8% (3)	
9 or more hours	12.5% (17)	13.7% (14)	8.8% (3)	
Typical time to first use upon waking ^a				.387
Within 30 min	11.8% (16)	11.7% (12)	11.8% (4)	
31 min to almost 1 hr	19.1% (26)	19.6% (20)	17.7% (6)	
1 to almost 2 hr	16.9% (23)	15.7% (16)	20.6% (7)	
2 to almost 4 hr	13.2% (18)	13.7% (14)	11.8% (4)	
4 or more hours	39.0% (53)	39.2% (40)	38.2% (13)	
Total past 30 day drinking days	4.6 (6.5)	4.0 (5.7)	5.4 (8.2)	.353

^aOnly participants who used cannabis in the past 30 days were asked to complete this item.

cannabidiol (CBD), drinking alcohol, smoking tobacco, vaping nicotine, and exercising. We assessed changes in eating and social activities. Participants rated the degree to which they agreed or disagreed that COVID-19 had impacted their lives in positive and negative ways (responses on a five-point scale from strongly disagree to strongly agree). We asked an open-ended question, "please describe the ways that the coronavirus (COVID-19) pandemic has or has not affected your life," which is presented in the qualitative analysis below.

Cannabis and alcohol use

Participants completed an online Timeline Follow Back assessing past 30 day cannabis and alcohol use days [32–34]. Items regarding past 30 day cannabis use methods, medical cannabis certification, sources of cannabis acquisition, hours high per day, and time to first use upon waking were adapted from prior work [35–37]. When answering questions about cannabis, participants were prompted to respond about products containing THC and to exclude reporting on "CBD-only" products.

Mental health

We used two-item screening measures for depression (PHQ-2) and anxiety symptoms (GAD-2) in the past 2 weeks [38–40]. Participants were coded as screening positive or negative using established clinical cutoffs (≥ 3) with acceptable sensitivity (PHQ-2: 83%, GAD-2 = 86%) and specificity (PHQ-2: 92%, GAD-2 = 83%).

Analyses

We provide quantitative data in the form of means, standard deviations (*SDs*), and proportions of participants. After using chi-squared and *t*-tests for preliminary examination to conclude that Wave 1 and Wave 2 participants did not substantially differ on demographics and cannabis use indicators (see [Tables 1](#) and [2](#)), we pooled data from the two cohorts for this descriptive paper since each group completed measures close in time (May and June 2020). We used chi-square analyses to examine relationships between perceived changes in cannabis consumption and negative emotions. We conducted content analysis of responses to the single qualitative item. The first author reviewed ~50% of responses and noted emerging themes for a codebook of potential response categories, then incorporated the last author's feedback. The first author trained the second and third authors in the coding scheme. The two coders independently coded 10 responses, then resolved discrepancies and clarified code definitions with the first author. Next, they coded 15 responses and met with the first author to resolve discrepancies and refine code definitions prior to coding the remaining responses. The first author reviewed this coding and resolved discrepancies, which, out of 291 codes applied (across two coders), occurred on 70 occasions (76% agreement on initially applied codes). Codes were enumerated to assess the prevalence of themes in participants' responses.

RESULTS

Sample demographics and descriptive information

Cannabis-using participants ($N = 141$) were, on average, 21.1 years old ($SD = 2.2$), with 56.7% female. Most were White (70.2%), though Black/African American individuals (19.9%; remaining 9.9% of other races) were represented. About one-fifth (21.3%) identified as Hispanic/Latinx individuals (21.3%). The majority were unmarried (96.5%) and nine individuals had children (6.4%). Almost half (41.1%) screened positive for depression and anxiety (45.4%). Nearly all (96.5%) reported past 30 day cannabis use, with smoking (88.7%) the most frequent method. [Tables 1](#) and [2](#) show demographics and information on recent cannabis and alcohol use, and there were no significant differences between $n = 105$ who did not receive an intervention and $n = 36$ who did receive the intervention,

with one exception. The distribution of education level differed such that, in nonintervention participants ($n = 105$), 15.2% completed high or less, 61.9% had some college/technical school or an Associate's Degree, and 22.9% had a bachelor's degree or higher; in the $n = 36$, who received the intervention rates were: 41.7%, 50.0%, and 8.3%, respectively ($p = .002$). Additionally, out of several items assessing cannabis sources, three differed significantly between nonintervention recipients (29.5% dealer, 42.8% recreational dispensary, 0.0% other) and intervention recipients (50.0%, $p = .026$; 8.3%, $p < 0.001$; 5.5%, $p = .015$; respectively). Given that analyses do not focus on education status or cannabis sources, and there were no other significant differences in [Tables 1](#) and [2](#), all further data are reported for for the combined sample.

Perceived COVID-19 impacts on participants

Few participants reported COVID-19 symptoms (16.3%); 5.0% ($n = 7$) contacted a health provider with three reporting negative testing and four reporting not being tested (none were hospitalized). Some reported known infections amongst household (7.1%) and other social network members (54.6%). Regarding employment, 19.2% lost income (e.g., fewer hours), 23.4% lost their job and were not working, and 7.1% lost their job but started a new one. Four of the nine parents lost childcare (four did not use childcare), and seven had their child's school closed (two did not have children in school). About half of the participants reported that unhealthy eating increased and that exercise decreased ([Table 3](#)). Reduced in-person social activities were reported by nearly everyone, while online social activities increased in about two-thirds.

Social isolation and cannabis use

The majority (86.4%) reported social isolation (quarantine and stay-at-home order), with $M = 58.6$ ($SD = 26.6$) days of isolation (to date). Among those indicating social isolation/quarantine, they reported that their cannabis use during quarantine was: a lot (33.9%) or a little more than usual (32.2%), same as usual (21.5%), or a little (5.8%) or a lot (6.6%) less than usual.

Changes in cannabis use, other behaviors, and emotions

[Table 3](#) shows perceived changes in emotions, cannabis use, and other behaviors during the pandemic relative to before the pandemic impacted participants' locales. A third to a half increased cannabis use, depending on consumption method, with 20%–30% reporting decreases across methods. CBD use was stable for nearly 60% of those who used it at all. About one-third decreased alcohol, tobacco, and vaping nicotine, and 20%–30% reported they increased the consumption of these substances. Combined with decreases in perceived hopefulness

Table 3 | Self-reported feelings and behaviors in the past 30 days compared to the 30 days before the pandemic affected participants' geographic areas

	Decreased somewhat/a lot	Stayed about the same	Increased somewhat/a lot
Smoking cannabis (<i>n</i> = 137)	18.2% (25)	32.8% (45)	48.9% (67)
Vaporizing cannabis (<i>n</i> = 119)	23.5% (28)	32.8% (39)	43.7% (52)
Dabbing cannabis (<i>n</i> = 89)	28.1% (25)	33.8% (31)	37.1% (33)
Eating cannabis (<i>n</i> = 102)	19.6% (19)	45.1% (46)	36.3% (37)
CBD (<i>n</i> = 68)	16.2% (11)	58.9% (40)	25.0% (17)
Alcohol (<i>n</i> = 126)	31.7% (40)	38.9% (49)	30.2% (37)
Smoking tobacco (<i>n</i> = 70)	34.3% (24)	45.7% (32)	21.4% (14)
Vaping nicotine (<i>n</i> = 67)	34.3% (23)	41.8% (27)	25.4% (17)
Feeling lonely	5.7% (8)	24.8% (35)	69.5% (98)
Feeling anxious	11.3% (16)	21.3% (30)	67.4% (95)
Feeling stressed	13.5% (19)	17.0% (24)	69.5% (98)
Feeling depressed	10.6% (15)	27.7% (39)	61.8% (89)
Feeling hopeful	53.9% (76)	34.8% (49)	11.3% (16)
Feeling happy	45.2% (67)	33.3% (47)	19.1% (27)
Unhealthy eating	13.8% (19)	31.2% (44)	55.3% (78)
Healthy eating	31.2% (44)	39.0% (55)	29.8% (42)
Exercise (<i>n</i> = 134)	50.7% (68)	19.4% (26)	28.4% (40)
In-person social activities	90.8% (128)	7.1% (10)	2.1% (3)
Online social activities	7.8% (11)	27.7% (39)	64.5% (91)

ns are smaller for behaviors that participants reported not engaging in during the past year.

and happiness (in ~50%), about two-thirds of participants reported that feelings, such as loneliness, anxiety, depression, and increased stress.

Table 4 shows results of chi-square analyses examining increases in cannabis use (increased vs. stayed same/decreased/no use), across method of use and negative emotions assessed. Individuals who reported that their cannabis smoking increased were significantly more likely to report increases in depression (70.2%), anxiety (80.6%), and stress (83.6%). There were no significant differences across methods of use and negative emotions for vaping and dabbing. Those who reported increased edible cannabis consumption were also more likely to report increased anxiety (81.1%).

Overall perceived impact of COVID-19

Participants' agreement with the statement "The coronavirus (COVID-19) pandemic has impacted my life in *positive* ways" was as follows: 6.4% strongly agreed, 29.8% agreed, 22.7% were neutral, 21.3% disagreed, and 19.9% strongly disagreed. Their ratings for a parallel statement focused on *negative* impacts were: 30.5% strongly agree, 46.1% agree, 18.4% neutral, 3.6% disagree, and 1.4% strongly disagree.

Table 5 provides exemplar quotes from open-ended responses about the impact of the pandemic on participants' lives. Overall, themes reflecting negative impacts were most prevalent, although positive aspects were mentioned. Negative impacts on employment and finances (33.3%), social isolation (29.4%), and stress or negative emotions, including worsening mental health (25.4%) were

most frequently mentioned. Perhaps of interest given the developmental age of the sample, uncertainty about the future (9.5%) and lost opportunities or milestones (9.5%) came up less frequently. Among positive themes, employment and finances were mentioned most frequently (13.5%) with some participants having increased income due to stimulus checks and federal unemployment benefits (increased by \$600/week) during the initial pandemic response. Some experienced positive emotions (11.1%) like reduced anxiety or relaxation. Very few spontaneously mentioned changes in cannabis use as a positive or negative impact of the pandemic, although they had already reported on this in the quantitative survey.

DISCUSSION

We have provided a unique snapshot of the perceived impact of the COVID-19 pandemic on the lives of emerging adults across the USA who regularly use cannabis. A few months into the events of the pandemic unfolding in the USA, many of these emerging adults were experiencing significant changes, including ongoing social isolation, increased loneliness, anxiety, and depression, lost wages or jobs, and/or changes in school or residence. Many participants felt that their use of cannabis increased during the pandemic, particularly when socially isolated (i.e., quarantine and stay-at-home orders), with rates similar to those reported previously [23]. Descriptively, there were more participants reporting perceived increases in cannabis use than there were reporting increased

Table 4 | Self-reported changes in past 30 day cannabis use and emotions relative to 30 days before the pandemic affected participants' geographic areas

	Feeling depressed		Feeling anxious		Feeling stressed	
	Decreased/ same	Increased	Decreased/ same	Increased	Decreased/ same	Increased
Smoking						
Decreased/same/ none	46.0% (34)	54.0% (40)	44.6% (33)	55.4% (41)	43.2% (32)	56.8% (42)
Increased	29.9% (20)	70.2% (47)	19.4% (13)	80.6% (54)	16.4% (11)	83.6% (56)
<i>p</i> -value	.050 ^a		.001		<.001	
Vaping						
Decreased/same/ none	42.7% (38)	57.3% (51)	34.8% (31)	65.2% (58)	29.2% (26)	70.8% (63)
Increased	30.8% (16)	69.2% (36)	28.9% (15)	71.2% (37)	32.7% (17)	67.3% (35)
<i>p</i> -value	.160		.465		.665	
Dabbing						
Decreased/same/ none	39.8% (43)	60.2% (65)	35.2% (38)	64.8% (70)	31.5% (34)	68.5% (74)
Increased	33.3% (11)	66.7% (22)	24.2% (8)	75.8% (25)	27.3% (9)	72.7% (24)
<i>p</i> -value	.503		.241		.646	
Eating						
Decreased/same/ none	40.8% (42)	59.2% (61)	37.9% (39)	62.1% (64)	33.0% (34)	67.0% (69)
Increased	29.7% (11)	70.3% (26)	18.9% (5)	81.1% (30)	24.3% (9)	75.7% (28)
<i>p</i> -value	.235		.035		.326	

^a*p* = .0496.

alcohol or tobacco/nicotine use, which was consistent across cannabis consumption methods. It is possible that the minority of the sample who felt their cannabis consumption decreased had limited access to cannabis during the pandemic; however, nearly all participants reported accessing cannabis in the prior month (and, for those of age, medical and recreational dispensaries were typically designated as “essential” businesses by local authorities).

Perhaps most concerning are the third to half of the sample who felt they increased their cannabis consumption due to the pandemic, given that greater frequency of consumption is correlated with greater severity of cannabis use disorder (CUD), which has a mean age of onset around 21 years [41] and is associated with greater risk for depression and anxiety disorders [42]. However, we did not assess the diagnosis of CUD, which should be included in future research to characterize the severity of cannabis use. Nonetheless, the clinical features of the sample (over 40% with possible depression, greater than 6.4% annual prevalence of major depression for young adults [43]) and the large proportions reporting increased depressive feelings raise alarm given the association between mood disorders and escalation of cannabis use disorder severity [44]. Although we could not examine causal effects in these one-time COVID-19 survey questions, because the majority of participants reported changing their cannabis use in the wake of the pandemic, it seems

clear that COVID-19 has far-reaching impacts on other areas of public health beyond disease transmission. This concern is underscored by the finding that pandemic-related increases in negative emotional states coincided with reports of increased cannabis smoking in particular. That many participants also increased unhealthy eating and decreased exercise underscores findings from a recent Brazilian study, which found that increased unhealthy behaviors were associated with loneliness, sadness, and anxiety [45], particularly for young people.

Notably, proportions reporting increased drinking alcohol, smoking tobacco, and vaping nicotine were lower than proportions reporting increased cannabis use. That finding could possibly relate to the fact that fewer participants used these other substances (i.e., cannabis was the inclusion criteria for this study). Overall, changes in substance use, including cannabis, can reflect a number of possibilities, including changes in access or environment, changes in use motives (i.e., increased coping and decreased socialization with >90% reporting decreased in-person social activities), increased or decreased craving, concerns about health, changes in finances affecting ability to purchase, changes in daily structure (e.g., working or completing school from home), and so on. The potential fallout in these areas due to the pandemic remains to be seen.

The emotional toll of the pandemic is evident among these emerging adults, many of whom were

Table 5 | Negative and positive impacts of COVID-19 (N = 126)

Topic (% , n mentioned) Brief definition	Exemplar quote
Negative impacts	
Employment/finances (33.3%, 42): Reduced hours/wages, job loss, inability to obtain employment, strained finances.	"I had just gotten a job after not having one for a year and it really had messed things up for me." "Income took a very big hit."
Social isolation (29.4%, 37): Boredom, lack of social interaction, sees others less frequently	"My support system of friends and family are far away now and I feel alone." "I can't see my friends from out of town, or go out and do anything."
Stress/negative emotions (25.4%, 32): Increased stress, worry, fear, depression, anxiety, or other mental illness symptoms.	"My depression and anxiety have gotten so bad that my eating disorder has returned."
Other negative impacts (17.5%, 22): Negative experience or perception not elsewhere categorized. Includes general sense of a negative impact.	"Everything is awkward in public and now I realize how many stupid people there are." "This has been bad."
Relocation or restricted mobility (14.3%, 18): Had to relocate or cannot move or travel when planned to do so.	"I am back home with family instead of my apartment at college." "Unable to travel."
Relationships (13.5%, 17): Relationship (friend, family, household member, partner, etc.) negatively affected.	"It also destroyed a romantic relationship." "Several people I am close to believe the virus is fake and/or exaggerated so they are not taking it seriously which is straining the relationship."
Academics (10.3%, 13): Worse academic performance, school canceled.	"Not being able to study properly for finals." "Rest of spring semester moved to online after spring break. Did not enjoy online classes, perhaps would have had more motivation for in-person classes."
Uncertainty about the future (9.5%, 12): Uncertainty about where life is going, what one's life will look like, experience of the world; existential crisis.	"It's made things seem really uncertain when it comes to deciding how to go on with my life from here." "My future plans are off course."
Lost opportunities (9.5%, 12): Loss of important events, milestones, or opportunities.	"I'm a senior, so I'm missing out on a lot of milestones like prom, graduation, and my senior show." "Many events that I was supposed to be involved in are cancelled."
Unhealthy activities (2.4%, 3): Poor diet, exercise; lack of self-care or productivity.	"I find it hard to keep a good routine." "I can't go exercise to help my brain condition, or to lose weight."
Cannabis use (2.3%, 3): Increased cannabis consumption.	"In order for me to cope more I've been smoking so much more weed." "I'm home a lot more so I dedicate more of my time to using THC."
Positive impacts	
Employment/finances (13.5%, 17): Positive job experience, increased finances, gratitude for maintaining job/income.	"Unemployment checks are more than I make at my regular job with the stimulus bonus." "I've never made this much money before working the last 11 years, which was definitely a positive impact because I could afford things."
Positive emotions (11.1%, 14): Positive emotions, decreased negative emotions, improved mental health, positive self-reflection including general gratitude.	"My anxiety levels have decreased." "I'm enjoying being at home to be honest. It's been relaxing."
Relationships (6.4%, 8): Positive aspects of relationships with family, friends, or others.	"I have been able to spend more time with my significant other and grow our relationship." "This pandemic has brought me and my family together/stronger."
Healthy (5.6%, 7): Increased exercise, healthy eating, or other health behaviors/self-care.	"I've never had access to this much healthy food before because food stamps is giving full amounts." "I have focused more on self-care."
Academics (4.8%, 6): Positive impact on grades, improved focus, or enjoyment of online learning.	"Grades improving." "I've gotten the chance to exclusively focus on online classes"
Other positive impacts (4.8%, 6): Positive experience or perception not elsewhere categorized. Includes general sense of a positive impact.	"I always wanted more time, now I have it." "There is good [and there is bad]."

(Continued)

Table 5 | Continued

Topic (% , n mentioned) Brief definition	Exemplar quote
Productivity (3.2%, 4): Ability to get more done or work on projects.	"I have had a lot of time to work on important projects I didn't have the time for." "It helped me have more time to do things I need."
Hobbies (3.2%, 4): Takes up a new hobby, increases hobbies.	"New hobbies." "I'm exploring new hobbies like cooking, baking and the arts."
Cannabis (1.6%, 2): Reduced cannabis consumption.	"Smoking less." "The pandemic and resulting isolation provided me with an excuse to stop purchasing and smoking marijuana. With restrictions ending soon, I may be tempted to purchase again. It is my wish to use marijuana more responsibly, but I do not trust myself to do so."
Alcohol (0.8%, 1): Reduced alcohol consumption	"I've drastically decreased my consumption of alcohol recently."

N = 126 because 15 people skipped this item; 9 people also mentioned no impact of COVID-19 and 7 people mentioned a neutral statement.

symptomatic for depression or anxiety based on clinical screeners (although these may possibly overestimate the presence of a clinical diagnosis). Consistent with a recent report documenting pandemic-related increases in mental health symptoms and coping-related substance use [2], most participants surveyed reported increases in loneliness, anxiety, stress, and depression and decreases in hopefulness and happiness. Still, although the majority felt that the pandemic has negatively impacted their lives, some found positive impacts. This nuanced impact is underscored by the qualitative data showing that some participants identified bright sides, such as temporary increases in income due to unemployment benefits, less anxiety or stress, and being able to cultivate some relationships during this stressful time (perhaps given this generation's underlying familiarity with technology-mediated communication, such as video chat and social media). It will be important to continue to monitor the cumulative impact of ongoing changes in psychosocial responses to the pandemic in vulnerable populations.

Despite the novelty of this work and the depth of our assessment, our study has inherent limitations. First, COVID-19 is an unfortunate situation, yet it provided an opportunity to embed questions in an ongoing study wherein some participants had received a pilot intervention, which is a limitation of the current analysis focused on COVID-19, despite the importance of cannabis interventions for public health. Note that we do provide descriptive information for those who did and did not receive an intervention, showing no differences in cannabis consumption, and few other differences. While the intervention may have altered some individuals' cannabis use in particular, we cannot examine intervention outcomes during an ongoing trial. Instead, we rely on participants' self-reported perceptions of changes related to the pandemic and not the intervention itself (which included ~25% of the present sample) as our COVID-19 survey prompts were phrased in relation to the pandemic. The sample

size is a limitation and precluded a number of statistical analyses (such as comparisons by state cannabis policy) yet nonetheless adds substantively to the field given we have not yet uncovered other research that includes such an in-depth assessment of individuals who use cannabis regularly. Although this small sample from a pilot study is not nationally representative, a major strength of this paper is the involvement of a sample of clinical interest and the rich assessment data, which can provide a starting point for more generalizable research studies. Finally, causal interpretations are beyond the scope of these cross-sectional data.

Limitations notwithstanding, this paper presents novel data regarding individuals' perceptions of the impact of the COVID-19 pandemic in the USA, particularly among youth regularly using cannabis. While disease prevention remains a priority, psychosocial impacts are emerging and should be fully understood and addressed. Emerging adults are in a vulnerable position in the life course and emotional stressors combined with disrupted financial and educational opportunities could have long-lasting impacts on their life trajectories. Ongoing stress and social isolation among young people who are using cannabis regularly could escalate the potential consequences of cannabis use. Public health interventions targeting reduced substance use and bolstering resilience and coping are urgently needed on a large scale to help address this aspect of the COVID-19 crisis.

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Compliance with Ethical Standards

Conflicts of Interest: The authors do not have any personal financial interests related to this manuscript, with two exceptions. M.W. is a minor shareholder in Facebook and has a conflict of interest plan approved by the

University of Michigan. S.Y. has received an unrestricted gift from Facebook, on file with the University of California, Los Angeles (his prior academic appointment).

Authors' contributions: Dr. Bonar conceptualized the study and led the drafting of the manuscript. Ms. Chapman provided project management and assistance with coding data and reviewed and edited the paper for important scientific content. Dr. McAfee assisted with coding data and reviewed and edited the paper for important scientific content. Dr. Goldstick advised on statistical analysis and reviewed and edited the paper for important scientific content. Drs. Bauermeister, Carter, Young, and Walton assisted with conceptualization and execution of the study and reviewed and edited the paper for important scientific content.

Ethical Approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

Informed Consent: Informed consent was obtained from all individual participants included in the study.

Transparency Statements

Study registration: The parent study from which these data were drawn was preregistered at ClinicalTrials.gov NCT04187989. This specific, time-sensitive, secondary analysis was not preregistered.

Analytic plan preregistration: The analysis plan for this time-sensitive, largely descriptive paper was not formally preregistered.

Data availability: Deidentified data from this study are not available in a public archive; trial analysis is not complete. Deidentified data from this study may be made available in the future (as allowable according to institutional review board standards) by emailing the corresponding author.

Analytic code availability: Analytic code used to conduct the analyses presented in this study are not available in a public archive. This may be available by emailing the corresponding author.

Materials availability: Materials used to conduct the study are not publicly available. This trial is not complete.

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