COVID-19 Vaccine Uptake and Attitudes Within Two Cohorts of Younger Adult Cannabis Users

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Abstract
It is crucial to understand COVID-19 vaccine uptake and attitudes among young adult cannabis users given the lowest vaccination rates among young adults and negative association between cannabis use and willingness to get vaccinated. 18–21-year-old and 26–33-year-old cohorts of cannabis users, recruited in California, were surveyed about the COVID-19 vaccine uptake/attitudes between March-August 2021. Cannabis use/demographic differences were investigated by vaccination status. Vaccine attitudes data were categorized and presented descriptively. 44.4% of the older and 71.8% of the younger cohorts were vaccinated. Non-Hispanic Black/African American race/ethnicity, lack of health insurance, and medicinal orientation towards cannabis use were negatively associated with vaccine receipt within the older cohort. For both cohorts, top reasons for vaccine hesitancy and rejection were concerns about speed of development, potential side effects, natural immunity, and lack of trust of vaccines. Our results highlight greater vaccine hesitance/rejection and need for targeted interventions among mid-20’s-early-30’s cannabis users.

Keywords
COVID-19 vaccine, vaccine hesitancy, young adults, medical cannabis use

Introduction
In the U.S., vaccinations against COVID-19 began on December 14, 2020, when the Food and Drug Administration granted emergency authorization to Pfizer-BioNTech COVID-19 vaccine.
though vaccine allocation was initially limited to high-risk groups (i.e., health care and essential workers, geriatric populations, adolescents and adults with high-risk medical conditions, including smoking) (Dooling et al., 2021; Money & Shalby, 2021; U.S. Department of Health & Human Services, 2021). Californians aged 16 and older became eligible for the COVID-19 vaccine starting April 15, 2021 (Money & Shalby, 2021). As of September 2022, over 263 million had received at least one dose of the COVID-19 vaccine and over 224 million were fully vaccinated in the U.S. (Center for Disease Control and Prevention, 2022).

Young adults aged 18–29 years account for the most COVID-19 cases, the lowest COVID-19 vaccination coverage, and rank highest among unvaccinated persons who “probably or definitely will not get vaccinated” relative to other age groups (Center for Disease Control and Prevention, 2022; Hamel et al., 2021b). Several demographic factors have been found to be associated with vaccine uptake within a general population. More specifically, a smaller proportion of non-Hispanic Black individuals, those without health insurance, and those with less than bachelor’s degree received at least one dose of the vaccine (Bhuyan et al., 2021; Center for Disease Control and Prevention, 2022; Hamel et al., 2021b). However, little is known about what demographic factors impact vaccine uptake among young adults.

Emerging research indicates increased rates of cannabis use during the COVID-19 pandemic among adult (Boehnke et al., 2020; Cousijn et al., 2021; van Laar et al., 2020; Vidot et al., 2021) and young adult (Bartel et al., 2020; Clendennen et al., 2021) cannabis users partially related to coping with mental health problems (e.g., stress, anxiety, and depression). Additionally, existing evidence suggests the possibility of a more severe COVID-19 disease progression among cannabis smokers (Wei & Shah, 2020) due to THC-related immunosuppression (Cabral & Jamerson, 2014) and higher risk of COPD (Tan et al., 2009) within this group. However, a recent study concluded that higher lifetime cannabis use was negatively associated with willingness to get a COVID-19 vaccine (Spechler et al., 2021). Despite increases in cannabis use during the COVID-19 pandemic and lower vaccination rates among young adults which potentially heightens vulnerability to severe complications of COVID-19 among cannabis smokers, no study to date has examined vaccine uptake in relation to specific cannabis practices (i.e., frequency, amount, reasons for use) and barriers to vaccination among younger adult cannabis users.

This study presents preliminary data on a COVID-19 vaccine uptake and associated demographic and cannabis use factors, as well as attitudes towards a COVID-19 vaccine among two cohorts of younger adult cannabis users in California. Results of this study may inform policy makers and public health professionals as to whether additional interventions are needed to increase vaccine uptake among young adult cannabis users through addressing barriers to vaccination to better reduce the spread and severity of COVID-19.

**Methods**

Two longitudinal cohorts of younger adult cannabis users were surveyed quantitatively about COVID-19 vaccination status and attitudes towards a COVID-19 vaccine between March 2nd and August 10th, 2021. Participants in an older cohort, recruited in Los Angeles, California, in 2014–2015, were 26–33 years old at the time of data collection (Lankenau et al., 2017). Participants in a younger cohort, recruited in Los Angeles, California, in 2019–2020, were 18–21 years old at the time of data collection. Both cohorts were recruited via targeted (e.g., medical and recreational cannabis dispensaries, college campuses, parks, Craigslist) and chain referral sampling strategies (Biernacki & Waldorf, 1981; Watters & Biernacki, 1989). Eligibility criteria for both cohorts were having a current valid medical cannabis recommendation, which was visually inspected by interviewers at the time of the baseline survey, or never having a medical cannabis
recommendation; reporting using cannabis at least 4 times within 30 days prior to enrollment; residing in Los Angeles metro area; being able to read and speak English; being 18–26 years old for the older cohort or 18–20 years old for the younger cohort at the time of enrollment. All participants provided informed consent to participate in the study. Participants completed annual surveys and short surveys distributed every 3 months in between annual surveys. Within the younger cohort, baseline data was collected face-to-face up until March 2020, and via Zoom or WebEx from March 2020. All other surveys were completed via Research Electronic Data Capture (REDCap) online survey link. COVID-19 vaccine data was derived from the most recent data point available for each participant and resulted in two sets on analyses: one focused on vaccination status and a second centered on attitudes towards a COVID-19 vaccination.

During annual and short surveys, participants were asked whether they received a COVID-19 vaccine (yes/no). Each cohort was divided into two groups (Vaccinated/Not Vaccinated) based upon vaccination status (see Table 1). Chi-square or Kruskal–Wallis tests examined differences in demographic (i.e., gender, race/ethnicity, education, employment, health insurance) and cannabis

| Table 1. Demographic Characteristics, Cannabis Use, and COVID-19 Vaccination Status. |
|-----------------------------------------------|---|---|---|---|---|---|
|                                   | Older cohort | | | Younger cohort | | |
|                                   | % (n) | % (n) | % (n) | % (n) | % (n) | % (n) |
| Total                            | n = 169 | 44.4 (75) | 55.6 (94) | n = 71 | 71.8 (51) | 28.2 (20) |
| Vaccinated                       |          |          |          |          |          |          |
| Not vaccinated                   |          |          |          |          |          |          |
| Male                             | 58.0 (98) | 58.7 (44) | 57.4 (54) | 39.4 (28) | 31.4 (16)* | 60.0 (12) |
| Ethnicity                        |          |          |          |          |          |          |
| Hispanic/Latinx                  | 46.1 (77) | 43.2 (32) | 48.4 (45) | 43.7 (31) | 45.1 (23) | 40.0 (8) |
| Non-Hispanic race                |          |          |          |          |          |          |
| White                            | 30.5 (51) | 39.2 (29)* | 23.7 (22) | 29.6 (21) | 31.4 (16) | 25.0 (5) |
| Black/African American           | 12.0 (20) | 5.4 (4)* | 17.2 (16) | 8.5 (6) | 0.0 (0) | 30.0 (6) |
| Multi-racial                     | 7.2 (12) | 6.8 (5) | 7.5 (7) | 5.6 (4) | 5.9 (3) | 5.1 (1) |
| Asian/Pacific Islander           | 4.2 (7) | 5.4 (4) | 3.2 (3) | 12.7 (9) | 17.6 (9) | 0.0 (0) |
| Some college or above            | 84.3 (140) | 95.9 (71) | 75.0 (69) | 73.2 (52) | 74.5 (38) | 70.0 (14) |
| Currently at school              | 20.7 (35) | 16.0 (12) | 24.5 (23) | 88.7 (63) | 94.1 (48)* | 75.0 (15) |
| Employed                         | 65.3 (109) | 71.2 (52) | 60.6 (57) | 57.1 (40) | 60.0 (30) | 50.0 (10) |
| Health insurance                 | 74.1 (120) | 84.7 (61)** | 65.6 (59) | 95.7 (67) | 96.1 (49) | 94.7 (18) |
| Medicinal orientation            | 52.9 (74) | 41.8 (28)* | 63.0 (46) | 40.8 (29) | 39.2 (20) | 45.0 (9) |
| Cannabis use                     |          |          |          |          |          |          |
| Cannabis days, mean (SD)         | 53.5 (36.9) | 50.4 (36.6) | 56.0 (37.1) | 62.4 (28.8) | 63.9 (28.1) | 58.6 (31.2) |
| More than 1/8 of an ounce of cannabis per week | 60.6 (86) | 54.7 (35) | 65.4 (51) | 63.6 (66) | 60.9 (28) | 70.0 (14) |
| Past 90-day reasons for cannabis use |          |          |          |          |          |          |
| To relieve physical pain         | 43.2 (73) | 41.3 (31) | 44.7 (42) | 40.8 (29) | 41.2 (21) | 40.0 (8) |
| To relieve feeling uptight or anxious | 44.4 (75) | 45.3 (34) | 43.6 (41) | 71.8 (51) | 76.5 (39) | 60.0 (12) |
| To help sleep                    | 58.6 (99) | 53.3 (40) | 62.8 (59) | 66.2 (47) | 68.6 (35) | 60.0 (12) |

*p < .05, **p < .01.
use (i.e., days, amount, medicinal orientation towards use (Fedorova et al., 2019) including reasons for use) variables based on vaccination status. Medicinal orientation towards cannabis use was derived from the following question: How would you characterize your use of cannabis over the past 90 days? Recreational use was defined as “to socialize with others, to increase creativity, or to make experiences more pleasurable, interesting, or exciting”) while medical use was defined as “to treat or help cope with any physical ailments, such as pain or discomfort, or psychological conditions, such as feeling anxious or sad, insomnia.” Those who selected “exclusively medical,” “primarily medical,” or “equally medical and recreational” were categorized as having medicinal orientation towards cannabis use.

In addition to the COVID-19 vaccination question, unvaccinated participants were asked whether they were planning, unsure, or not planning to get vaccinated. In a text box, all participants were asked to describe reasons behind behaviors and attitudes towards a COVID-19 vaccine (i.e., being vaccinated, planning to get vaccinated, being unsure about getting vaccinated and not planning to get vaccinated). Data derived from open-ended responses were analyzed inductively and generated a preliminary set of categories describing attitudes towards a COVID-19 vaccination. The first author coded all responses and developed the initial set of categories which were then discussed, refined, and finalized with other co-authors to ensure that the emerging set of attitudes towards the COVID-19 vaccination reliably matched open-ended responses. For instance, response “Because I believe in science and I want to mitigate my chances of getting covid, having a severe case, or spreading covid” was assigned to Protect myself & others category; response “I want to wait it out” was assigned to Too soon category. Responses from the same participant could be assigned to multiple categories (i.e., response “I do not trust the vaccine and it’s not a sure form of protection” was assigned to No trust and Ineffective categories). These categories were finalized and translated into two lists of attitudes towards the COVID-19 vaccination—“Vaccinated/Planning to Get Vaccinated” and “Unvaccinated (Unsure/Don’t Plan).” Ultimately, the frequency of these attitudes towards the COVID-19 vaccination—originally reported as text—were tabulated across the two cohorts (see Table 2).

All study procedures were approved by the Institutional Review Boards at Children’s Hospital Los Angeles and Drexel University.

Results

Among the older cohort, 44.4% (n = 75) reported receiving at least one shot of a COVID-19 vaccine and 8.3% (n = 14) reported planning to get vaccinated, while 47.3% were either unsure about getting the COVID-19 vaccine (n = 27) or did not plan to get vaccinated (n = 53). Among the younger cohort, 71.8% (n = 51) reported receiving at least one shot of the COVID-19 vaccine and 11.3% (n = 8) reported planning to get vaccinated, while 16.9% were either unsure about getting the COVID-19 vaccine (n = 4) or did not plan to get vaccinated (n = 8).

Both cohorts were primarily Hispanic/Latinx (46.1% older vs. 43.7% younger), were currently employed (65.3% older vs. 57.1% younger), had health insurance (74.1% older vs. 95.7% younger), and had some college education or above (84.3% older vs. 73.2% younger) (Table 1). Within the older cohort, medicinal orientation towards cannabis use (p < .05), being non-Hispanic Black/African American (p < .05), and lack of health insurance (p < .01) were negatively associated with vaccine receipt. Within the younger cohort, female gender (p < .05) and being currently at school (p < .05) were positively associated with vaccine receipt. Within both cohorts, cannabis use frequency (i.e., days of use) or amount, and reasons for cannabis use (i.e., for pain, anxiety, or sleep) were not associated with vaccine receipt.

Within the older cohort (Table 2), the top reasons for being vaccinated or planning to get vaccinated were: To protect myself & others (70.8%), Work requirement (13.5%), and Get back to
normal life (12.4%). Similarly, within the younger cohort, top reasons for being vaccinated or planning to get vaccinated were: To protect myself & others (66.1%), Get back to normal life (15.3%), and Work (10.2%) or School (8.5%) requirements. While the older cohort reported a greater variety of reasons for being unsure about getting vaccinated or not planning to get vaccinated, both cohorts had the same top reason—Too soon (30.0% older vs. 25.0% younger)—followed by Unsafe/side effects (18.8% older vs. 8.3% younger), No need/natural immunity (13.8% older vs. 16.7% younger), and No trust in vaccines (15.0% older vs. 8.3% younger).

### Discussion

Over 80% of our younger cohort (18–21-year-olds) had already received a COVID-19 vaccine or planned to get vaccinated as of August 2021. This finding is corroborated by national data where over 80% of 18–25-year-old adults were either vaccinated or planned to get vaccinated (Adams et al., 2021), while over 90% of a sample of undergraduates (mean age 21.8 years) intended to get vaccinated (Graupensperger et al., 2021). Therefore, our data suggests that cannabis use was not a factor in vaccination uptake or intent to get vaccinated within the younger cohort. In contrast, only slightly over a half of our older cohort (26–33-year-olds) reported either being vaccinated or planning to get vaccinated which was lower than vaccination uptake among 18–29-year-olds within a general population sample (Hamel et al., 2021b). Similarly, only 49.1% of adult cannabis and/or tobacco smokers were willing to get vaccinated (Yang et al., 2021). Greater acceptance of the COVID-19 vaccine by the younger cohort in our study could be due to the fact that a majority (88.7%) were students and educational institutions often require all on-campus students to be
vaccinated (Johnson, 2022). Moreover, being currently at school was positively associated with being vaccinated within the younger cohort.

Being Black/African American and not having health insurance was negatively associated with receiving a COVID-19 vaccine within the older cohort. Similar demographic characteristics associated with vaccine uptake and willingness to get vaccinated were reported in previous studies in both the general population (Bhuyan et al., 2021) and cannabis and/or tobacco smokers (Yang et al., 2021). Therefore, despite increasing vaccination uptake among Black/African Americans within the general population (Hamel et al., 2021a), our study demonstrated that racial disparities existed within a population of younger adult cannabis users at the time of data collection, which could be explained by structural barriers limiting access to a COVID-19 vaccinations among Black participants (Njoku et al., 2021) as well as a historic mistrust of government-developed medicine and vaccines in general compared to natural remedies, including cannabis (Dreher, 2002; Freimuth et al., 2017; Quinn et al., 2016). Racial disparities in vaccination rates are particularly concerning given the disproportionally higher rates of COVID-19 infection among Black/African Americans (Zelner et al., 2021).

Notably, cannabis amount, frequency, or reasons for use were not associated with vaccine uptake. However, a medicinal orientation towards cannabis use was negatively associated with a COVID-19 vaccine receipt within the older cohort, which may reflect longer exposure to a medical cannabis program resulting in a mistrust of pharmaceutical companies and belief in a greater effectiveness and safety of natural remedies, such as cannabis (Lucas et al., 2019).

The top reasons for receiving a COVID-19 vaccine or planning to get vaccinated in our sample were: To protect myself & others, Work/school requirements, and Get back to normal life. Too soon was the key reason for vaccine hesitancy and rejection in both cohorts. Unsafe/side effects and No trust in vaccines reasons were frequently reported by the older cohort. Accordingly, this “wait and see” attitude due to novelty of the vaccine and concerns about unknown side effects were the most cited barriers to a COVID-19 vaccination among other young adult, general population, and adult cannabis and/or tobacco smokers samples (Adams et al., 2021; Graupensperger et al., 2021; Hamel et al., 2021b; Yang et al., 2021).

Future intervention efforts should focus on cannabis users in their mid-20’s-early-30’s to address concerns around safety of a COVID-19 vaccine by providing and explaining the latest data on vaccine safety testing. Heightened vulnerability to a more severe COVID-19 disease progression due to cannabis smoking should be highlighted in targeted education campaigns through venues frequented by younger adult cannabis users, such as cannabis dispensaries or pertinent social media outlets.

A few limitations should be noted. First, our findings should be interpreted with caution given that analysis is based on convenience samples of younger adult cannabis users in Los Angeles, California, and may not be representative of all young adult cannabis users across the U.S. Second, data utilized in this analysis did not assess whether participants were fully vaccinated or whether they received a booster shot—only if they had received at least one shot of a COVID-19 vaccine. Third, a relatively small sample size within the younger cohort could limit our power to identify other statistically significant correlates of vaccination uptake, which will be explored once more data is aggregated.

**Conclusions**

Greater vaccine hesitance and rejection was observed within a cohort of mid-20’s-early-30’s cannabis users, especially among uninsured, Black/African Americans, and those who reported using cannabis medicinally. Unsupportive attitudes towards vaccination were primarily driven by concerns related to the recency and safety of a COVID-19 vaccine. Further investigation of factors
that can reduce vaccine hesitancy and rejection among mid-20’s-early-30’s cannabis users is warranted.

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References
Adams, S. H., Schaub, J. P., Nagata, J. M., Park, M. J., Brindis, C. D., & Irwin, C. E. (2021). Young adult perspectives on COVID-19 vaccinations. Journal of Adolescent Health, 69(3), 511–514. https://doi.org/10.1016/j.jadohealth.2021.06.003
Bartel, S. J., Sherry, S. B., & Stewart, S. H. (2020). Self-isolation: A significant contributor to cannabis use during the COVID-19 pandemic. Substance Abuse, 41(4), 409–412. https://doi.org/10.1080/08897077.2020.1823550
Bhuyan, S., Rittweger, A., Rubin, J. S., & Cantor, J. C. (2021). Trends in COVID-19 vaccination in the United States. Edward J. Bloustein school of planning and public policy. Rutgers University.
Biernacki, P., & Waldorf, D. (1981). Snowball sampling: Problems and techniques of chain referral sampling. Sociological Methods & Research, 10(2), 141–163. https://doi.org/10.1177/0049124181010000205
Boehnke, K. F., McAfee, J., Ackerman, J. M., & Kruger, D. J. (2020). Medication and substance use increases among people using cannabis medically during the COVID-19 pandemic. International Journal of Drug Policy, 2020, Article 103053. https://doi.org/10.1016/j.drugpo.2020.103053
Cabral, G. A., & Jamerson, M. (2014). Marijuana use and brain immune mechanisms. International Review of Neurobiology, 118, 199–230. https://doi.org/10.1016/B978-0-12-801284-0.00008-7
Center for Disease Control and Prevention (CDC) (2022). COVID data tracker. Retrieved from https://covid.cdc.gov/covid-data-tracker/#datatracker-home (Accessed September 15, 2022).
Clendennen, S. L., Case, K. R., Sumbe, A., Mantey, D. S., Mason, E. J., & Harrell, M. B. (2021). Stress, dependence, and COVID-19–related changes in past 30-day marijuana, electronic cigarette, and cigarette use among youth and young adults. Tobacco Use Insights, 14, 1–7. https://doi.org/10.1177/1179173x211067439
Cousijn, J., Kuhns, L., Larsen, H., & Kroon, E. (2021). For better or for worse? A pre-post exploration of the impact of the COVID-19 lockdown on cannabis users. Addiction. https://doi.org/10.1111/add.15387
Dooling, K., Marin, M., Wallace, M., Meclung, N., Chamberland, M., Lee, G. M., Talbot, H. K., Romero, J. R., Bell, B. P., & Oliver, S. E. (2021). The advisory committee on immunization practices’ updated
interim recommendation for allocation of covid-19 vaccine—United States. *Morbidity and Mortality Weekly Report*, 69(5152), 1657–1660.

Dreher, M. (2002). Crack heads and roots daughters: The therapeutic use of cannabis in Jamaica. *Journal of Cannabis Therapeutics*, 2(3–4), 121–133. https://doi.org/10.1300/J175v02n03_08

Fedorova, E. V., Schrager, S. M., Robinson, L. F., Cepeda, A., Wong, C. F., Iverson, E., & Lankenau, S. E. (2019). Illicit drug use and prescription drug misuse among young adult medical cannabis patients and non-patient users in Los Angeles. *Drug and Alcohol Dependence*, 198(January), 21–27. https://doi.org/10.1016/j.drugalcdep.2019.01.026

Freimuth, V. S., Jamison, A. M., An, J., Hancock, G. R., & Quinn, S. C. (2017). Determinants of trust in the flu vaccine for African Americans and Whites. *Social Science & Medicine*, 193, 70–79. https://doi.org/10.1016/j.socscimed.2017.10.001

Graupensperger, S., Abdallah, D. A., & Lee, C. M. (2021). Social norms and vaccine uptake: College students’ COVID vaccination intentions, attitudes, and estimated peer norms and comparisons with influenza vaccine. *Vaccine*, 39(15), 2060–2067. https://doi.org/10.1016/j.vaccine.2021.03.018

Hamel, L., Lopes, L., Kearney, A., Sparks, G., Stokes, M., & Brodie, M. (2021b). *KFF COVID-19 vaccine monitor: June 2021*. Kaiser Family Foundation.

Hamel, L., Lopes, L., Sparks, G., Kirzinger, A., Kearney, A., Stokes, M., & Brodie, M. (2021a). *KFF COVID-19 vaccine monitor: September 2021*. Kaiser Family Foundation.

Johnson, R. (2022). What colleges require the COVID-19 vaccine? Best colleges. Retrieved from https://www.bestcolleges.com/blog/list-of-colleges-that-require-covid-19-vaccine/ (Accessed September 15, 2022).

Lankenau, S. E., Fedorova, E. V., Reed, M., Schrager, S. M., Iverson, E., & Wong, C. F. (2017). Marijuana practices and patterns of use among young adult medical marijuana patients and non-patient marijuana users. *Drug and Alcohol Dependence*, 170, 181–188. https://doi.org/10.1016/j.drugalcdep.2016.10.025

Lucas, P., Baron, E. P., & Jikomes, N. (2019). Medical cannabis patterns of use and substitution for opioids & other pharmaceutical drugs, alcohol, tobacco, and illicit substances; results from a cross-sectional survey of authorized patients. *Harm Reduction Journal*, 16(9), 1–11. https://doi.org/10.1186/s12954-019-0278-6

Money, L., & Shalby, C. (2021). All California adults can get COVID-19 vaccine next month. The Los Angeles Times. Retrieved from https://www.latimes.com/california/story/2021-03-25/all-california-adults-covid-vaccine-eligible-april (Accessed September 15, 2022).

Njoku, A., Joseph, M., & Felix, R. (2021). Changing the narrative: Structural barriers and racial and ethnic inequities in COVID-19 vaccination. *International Journal of Environmental Research and Public Health*, 18. https://doi.org/10.3390/ijerph18189904

Quinn, S., Jamison, A., Musa, D., Hilyard, K., & Freimuth, V. (2016). Exploring the continuum of vaccine hesitancy between African American and White adults: Results of a qualitative study. *PLoS Currents*, 8, 1–30.

Spechler, P. A., Stewart, J. L., Kuplicki, R., Aupperle, R., Bodurka, J., Guinjoan, S. M., Khalsa, S. S., Paulus, M. P., Savitz, J., & Victor, T. A. (2021). COVID-19 vaccine willingness and cannabis use histories. MedRxiv.

Tan, W. C., Lo, C., Jong, A., Xing, L., FitzGerald, M. J., Vollmer, W. M., Buist, S. A., & Sin, D. D. (2009). Marijuana and chronic obstructive lung disease: A population-based study. *Canadian Medical Association Journal*, 180(8), 814–820. https://doi.org/10.1503/cmaj.081040

U.S. Department of Health & Human Services (HHS) (2021). COVID-19 vaccine distribution. Retrieved from https://www.hhs.gov/coronavirus/covid-19-vaccines/distribution/index.html (Accessed September 15, 2022).

van Laar, M. W., Oomen, P. E., van Miltenburg, C. J. A., Vercoulen, E., Freeman, T. P., & Hall, W. D. (2020). Cannabis and COVID-19: Reasons for concern. *Frontiers in Psychiatry*, 11, Article 601653. https://doi.org/10.3389/fpsyt.2020.601653
Vidot, D. C., Islam, J. Y., Camacho-Rivera, M., Harrell, M. B., Rao, D. R., Chavez, J. V., Ochoa, L. G., Hlaing, W. M., Weiner, M., & Messiah, S. E. (2021). The COVID-19 cannabis health study: Results from an epidemiologic assessment of adults who use cannabis for medicinal reasons in the United States. *Journal of Addictive Diseases, 39*(1), 26–36. https://doi.org/10.1080/10550887.2020.1811455

Watters, J. K., & Biernacki, P. (1989). Targeted sampling: Options for the study of hidden populations. *Social Problems, 36*(4), 416–430.

Wei, Y., & Shah, R. (2020). Substance use disorder in the COVID-19 pandemic: A systematic review of vulnerabilities and complications. *Pharmaceuticals, 13*(7), Article 155. https://doi.org/10.3390/ph13070155

Yang, Y., Dobalian, A., & Ward, K. D. (2021). COVID-19 vaccine hesitancy and its determinants among adults with a history of tobacco or marijuana use. *Journal of Community Health, 46*(6), 1090–1098. https://doi.org/10.1007/s10900-021-00993-2

Zelner, J., Trangucci, R., Naraharisetti, R., Cao, A., Malosh, R., Broen, K., Masters, N., & Delamater, P. (2021). Racial disparities in Coronavirus Disease 2019 (COVID-19) mortality are driven by unequal infection risks. *Clinical Infectious Diseases, 72*(5), E88–E95. https://doi.org/10.1093/cid/ciaa1723

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