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## Research Paper

# The effect of the COVID-19 pandemic on prenatal cannabis use by pre-conception depression and anxiety status

Lyndsay A. Avalos<sup>a,\*</sup>, G. Thomas Ray<sup>a</sup>, Stacey E. Alexeeff<sup>a</sup>, Sara R. Adams<sup>a</sup>, Monique Does<sup>a</sup>, Deborah Ansley<sup>b</sup>, Lue-Yen Tucker<sup>a</sup>, Amy Conway<sup>b</sup>, Allison Ettenger<sup>b</sup>, Nancy Goler<sup>b</sup>, Kelly C. Young-Wolff<sup>a,c</sup>

<sup>a</sup> Division of Research, Kaiser Permanente Northern California, Oakland CA, USA

<sup>b</sup> Regional Offices, Kaiser Permanente Northern California, Oakland CA, USA

<sup>c</sup> Department of Psychiatry and Behavioral Sciences, University of California, San Francisco, CA, USA



## 1. Introduction

Cannabis use during pregnancy has risen in the U.S. over the past decade and is estimated to occur in 5%-8% of pregnancies.(Young--Wolff, Tucker et al. 2017, Volkow, Han et al. 2019) Pregnant individuals have been acutely impacted by the COVID-19 pandemic with changes to in-person prenatal care, limits on support persons in the delivery room, and concerns about heightened risks of SARS-CoV-2 infection for themselves and their fetuses.(ACOG 2021) These and other stressors such as "shelter-in-place" orders associated with the pandemic may have impacted individuals' decisions about using cannabis during pregnancy. In fact, an appreciable increase in prenatal cannabis use during the pandemic has been documented, from 6.8% in the 15 months prior to the pandemic to 8.1% in the first 9 months of the pandemic.(Young--Wolff, Ray et al. 2021)

Depression, anxiety and stress have been reported as reasons for cannabis use among pregnant individuals(Ko, Coy et al. 2020) and an association between cannabis use and depression and anxiety during pregnancy has been documented.(Young-Wolff, Sarovar et al. 2020) Thus, pregnant individuals with a recent history of depression or anxiety may be particularly susceptible to cannabis use during the pandemic. Using data from Kaiser Permanente Northern California's (KPNC) integrated healthcare delivery system which universally screens for prenatal cannabis use, this study evaluates the effect of the COVID-19 pandemic on the rates of maternal prenatal cannabis use by pre-conception depression and anxiety diagnoses status.

## 2. Methods

### 2.1. Setting and study population

Kaiser Permanente Northern California (KPNC) provides medical care to over 4.3 million members. KPNC members are covered by employee-sponsored insurance plans, the insurance exchange and Medicaid. Information on diagnoses, hospitalizations, outpatient visits, and prescribed medications are maintained within administrative and electronic health records (EHR). Universal drug urine toxicology testing is standard upon entrance into prenatal care (at approximately 8 weeks gestation). This study included all KPNC pregnancies screened for cannabis via urine toxicology between January 1, 2019 and December 31, 2020.

The KPNC Institutional Review Board approved and waived consent for this study.

### 2.2. Measures

Pandemic period. The pre-pandemic period was defined as urine toxicology tests conducted during January 2019-March 2020 and the pandemic period was defined as those conducted during April 2020-December 2020.

Prenatal cannabis use was defined as a positive urine toxicology test for cannabis at entrance to prenatal care (approximately 8 weeks gestation). Confirmatory laboratory tests were performed for positive toxicology tests.

Preconception depression and anxiety ICD-10 codes (listed in footnote in Table 1) in the 365 days before the first day of the last menstrual period were ascertained from the EHR. Depression or anxiety diagnoses

\* Corresponding author.

E-mail address: [Lyndsay.A.Avalos@kp.org](mailto:Lyndsay.A.Avalos@kp.org) (L.A. Avalos).

**Table 1**

Descriptive Characteristics of the pregnancies screened for cannabis use by urine toxicology test in Kaiser Permanente Northern California between January 1, 2019 and December 31, 2020, overall and by before and during the COVID-19 pandemic.

Characteristic	Overall (n=100,005)	Timing of Urine Toxicology Test <sup>a</sup>	
		Before COVID-19 (n=62,837)	During COVID-19 (n=37,168)
Age Group, n (%)			
< 25 yrs	12,529 (12.5)	7,928 (12.6)	4,601 (12.4)
25 - <35 yrs	62,467 (62.5)	39,215 (62.4)	23,252 (62.6)
35+ yrs	25,009 (25.0)	15,694 (25.0)	9,315 (25.1)
Race/ethnicity, n (%)			
Asian or Pacific Islander	26,254 (26.3)	16,701 (26.6)	9,553 (25.7)
Black	6,803 (6.8)	4,255 (6.8)	2,548 (6.9)
Hispanic	27,612 (27.6)	17,315 (27.6)	10,297 (27.7)
Other/unknown/multi-racial	4,957 (5.0)	2,960 (4.7)	1,997 (5.4)
Non-Hispanic White	34,379 (34.4)	21,606 (34.4)	12,773 (34.4)
Pre-conception depression and anxiety status <sup>b</sup> , n(%)			
Neither depression nor anxiety	91,682 (91.7)	57,770 (91.9)	33,912 (91.2)
Depression only	2,213 (2.2)	1,401 (2.2)	812 (2.2)
Anxiety only	4,004 (4.0)	2,408 (3.8)	1,596 (4.3)
Comorbid depression and anxiety	2,106 (2.1)	1,258 (2.0)	848 (2.3)
Mean (median) gestational age at urine toxicology test, n(%)	58.3 (48.0)	59.5 (49.0)	56.3 (45.0)
Cannabis positive urine toxicology test, n(%)	7,242 (7.2)	4,218 (6.7)	3,024 (8.1)

<sup>a</sup> COVID-19 pandemic was considered to have begun for toxicology tests on or after April 1st, 2020

<sup>b</sup> Depression was defined as having 2 or more documentations of the following ICD-10 codes: F32.0-F32.4, F32.9, F33.0-F33.3, F33.41, F33.8-F33.9, F34.1, F34.8, F34.89, F34.9, F39, F43.21, F43.23. Anxiety was defined as having 2 or more instances of the following ICD-10 codes: F06.4, F40.00-F40.02, F40.10-F40.11, F40.210, F40.218, F40.220, F40.228, F40.230-F40.233, F40.240-F40.243, F40.240, F40.290-F40.291, F40.8-F41.1, F41.3, F41.8-F41.9, F42.\*, F43.10-F43.12, F43.22, F43.8.

documented at least two times were used to define four mutually-exclusive categories: depression only, anxiety only, comorbid depression and anxiety, neither depression nor anxiety.(Doktorchik, Patten et al., 2019)

Sociodemographic characteristics included age (<25, 25 to <35, 35+ years) and self-reported race/ethnicity (Asian or Pacific Islander, Black, Hispanic, non-Hispanic White, other/unknown/multi-racial) ascertained from the EHR.

### 2.3. Statistical Analysis

We computed monthly rates of prenatal cannabis use standardized to age in the year 2020, race/ethnicity, and depression/anxiety status distribution of the pregnancies in the overall study sample. We fit interrupted time-series (ITS) models to monthly rate data using Poisson regression to compare the rates of prenatal cannabis use in the pre-pandemic period to the pandemic period.(Penfold and Zhang 2013) The dependent variable in the Poisson ITS models was the monthly count of pregnancies with a positive urine toxicology test for cannabis, and the offset variable was the log of the number of pregnancies tested for cannabis in that month. Poisson models were adjusted for age group and race/ethnicity. Rates of prenatal cannabis use were modeled in the pre-pandemic period and the pandemic period for each depression and anxiety status category. We estimated the rate ratio for the change in rates of prenatal cannabis use in the pre-pandemic period to the pandemic period within each depression and anxiety status category. We then estimated the rate ratio for the change in rates for each depression and anxiety status category relative to the neither group. Initial ITS analysis models confirmed that rates of cannabis use before

and during the pandemic were stable, with no statistically significant month-to-month trends.(Young-Wolff et al., 2021) Our final models assessed the change in rates of cannabis use during the pandemic compared to before the pandemic. Our primary analysis fit a multiplicative Poisson model and secondary analyses fit an additive Poisson model (Boshuizen and Feskens, 2010) to assess absolute differences in the observed rates.

We report the rate ratios and rate differences and corresponding 95% confidence interval (CI). We conducted the analyses in SAS 9.4. Two-sided p-values <0.05 were considered statistically significant.

### 3. Results

The sample included 100,005 pregnancies (95,412 individuals) and was 26.3% Asian or Pacific Islander, 6.8% Black, 27.6% Hispanic, 34.4% non-Hispanic White, and 5% other/unknown/multi-racial, with a mean age of 31 (median=31) (Table 1). Approximately 7.2% of pregnancies had a positive cannabis urine toxicology test; 2.2% of pregnancies had a pre-conception depression diagnosis only, 4.0% had a pre-conception anxiety diagnosis only, and 2.1% had pre-conception comorbid depression and anxiety diagnoses. Negligible differences were documented in pregnancies during compared to before the pandemic in demographic characteristics such as race/ethnicity, gestational age at urine toxicology screening, and pre-conception mental health diagnoses (Table 1).

A 25% increase in prenatal cannabis use during the pandemic compared to the 15 months before was previously documented in this sample (adjusted rate ratio [aRR]: 1.25, 95% CI: 1.12, 1.49).(Young-Wolff et al., 2021) Among pregnancies without depression or anxiety, the rate of cannabis use increased significantly from 6.3% prior to the COVID-19 pandemic to 7.5% during (aRR: 1.20, 95% CI: 1.14, 1.27; Supplemental Figure, Table 2). Prior to the COVID-19 pandemic, the rate of cannabis use in pregnancies with depression only was 13.9%, higher than those with neither depression or anxiety. During the pandemic, this rate rose slightly to 14.7%, which was not a statistically significant increase (aRR: 1.06, 95% CI: 0.84, 1.33). Among pregnancies with anxiety only, the rate of cannabis use did not change significantly during the pandemic (11.1%) compared to prior (10.2%; aRR: 1.07, 95% CI: 0.88, 1.30).

Among those with comorbid depression and anxiety, the rate of prenatal cannabis use increased significantly to 20.6% during the pandemic from 14.6% before (aRR: 1.40, 95% CI: 1.14, 1.72). While the rates of prenatal cannabis use for comorbid depression and anxiety were nearly three times higher than rates for no depression or anxiety, the relative change in rates prior to compared to during the pandemic were not significantly different (aRR: 1.16, 95% CI: 0.94, 1.44).

On the absolute scale, among pregnancies without depression or anxiety, there was a small increase in cannabis use during the COVID-19 pandemic compared to before (adjusted risk difference [aRD]: 0.58 cases per 100 pregnancies, 95% CI: 0.35, 0.81). Among pregnancies with comorbid depression and anxiety the change in cannabis use during compared to before the pandemic was much larger (aRD: 5.89 cases per 100 pregnancies, 95% CI, 2.40, 9.38), and a significant absolute increase in cannabis use compared to pregnancies with neither depression or anxiety was noted (p<0.01). However, for pregnancies with depression only or anxiety only there was no significant change in prenatal cannabis use during compared to before the pandemic (aRD: 1.21, 95% CI: -1.75, 4.17; aRD: 0.44, 95% CI: -1.43, 2.31), and no relative significant absolute differences when compared to those without depression or anxiety for those with depression only (p=0.68) or anxiety only (p=0.88).

### 4. Discussion

This study documented that rates of maternal prenatal cannabis use both prior to and during the COVID-19 pandemic for those with pre-conception depression and/or anxiety were elevated by two to three

**Table 2**

Rate of prenatal cannabis use per 100 pregnancies before and during the COVID-19 pandemic by pre-conception depression and anxiety status.

			Multiplicative model <sup>a</sup>		Additive model <sup>a</sup>	
Pre-conception depression and anxiety status	Standardized rate before COVID-19	Standardized rate during COVID-19	During COVID-19 vs. before COVID-19, rate ratio (95% CI)	p-value relative to neither depression nor anxiety	During COVID-19 vs. before COVID-19, rate difference (95% CI)	p-value relative to neither depression nor anxiety
Neither depression nor anxiety	6.3	7.5	1.20 (1.14,1.27)*	ref	0.58 (0.35,0.81)*	ref
Depression only	13.9	14.7	1.06 (0.84,1.33)	0.29	1.21 (-1.75,4.17)	0.68
Anxiety only	10.2	11.1	1.07 (0.88,1.30)	0.25	0.44 (-1.43,2.31)	0.88
Comorbid depression and anxiety	14.6	20.6	1.40 (1.14,1.72)*	0.16	5.89 (2.40,9.38)*	<0.01

\* Significant at  $p < 0.05$ <sup>a</sup> Poisson models included adjustment for age and race.

times that of pregnancies without a history of these diagnoses. Additionally, increased rates of prenatal cannabis use associated with the COVID-19 pandemic were identified for individuals with comorbid pre-conception depression and anxiety as well as no pre-conception depression or anxiety. Finally, this study documented a significant absolute increase in prenatal cannabis use for comorbid pre-conception depression and anxiety relative to individuals without either diagnosis. This study is among the first to evaluate the impact of the COVID-19 pandemic on behaviors in pregnancy (Kar, 2021) and extends our prior work documenting an increase in prenatal cannabis use associated with the COVID-19 pandemic (Young-Wolff et al., 2021).

Elevated prenatal cannabis use has been reported previously among individuals with prenatal depression and anxiety (Young-Wolff et al., 2020). A history of depression and anxiety are significant risk factors for perinatal depression, which is associated with adverse health consequences for both the mother and infant (Grote et al. 2010, Mangla et al. 2019) and a growing body of literature suggests health effects of prenatal cannabis on the offspring (Gunn et al. 2016). The added effect of the pandemic on prenatal cannabis use for women with a history of depression and anxiety further highlights these individuals are an especially high-risk population.

#### 4.1. Limitations

Findings may not be generalizable to individuals not receiving prenatal care. Cannabis metabolites are most often detectable in urine for approximately 30 days, but may be detected longer depending on the potency and frequency of use. While it is unlikely, toxicology tests may have identified pre-conception use in some pregnancies. However, in our sample the urine toxicology tests were conducted on average 58.3 days (48.0 median) from the pregnancy start date. Therefore, we suspect it is unlikely that the urine toxicology tests identified pre-conception use in pregnancy. In addition, most individuals who use cannabis in pregnancy use prior to pregnancy (Young-Wolff et al., 2019). Thus, findings could represent either increases in use prior to pregnancy or that a greater percentage of individuals who used pre-conception are not quitting during early pregnancy. Findings represent cannabis use early in pregnancy and not continued use. This study is limited to addressing the potential differential effects of specific mental health disorders prior to pregnancy and future research may consider the severity of the disorders and/or other characteristics. This study included pregnant individuals with health insurance and thus findings may underestimate the rates in uninsured/underinsured and disadvantaged populations. Finally, individuals are not universally screened for depression or anxiety prior to pregnancy and some individuals may be misclassified.

#### 4.2. Strengths

Strengths of the current study include a large, diverse sample. Additionally, this study includes universal prenatal cannabis screening via urine toxicology for pregnant individuals over a two-year period

including the first 9 months of the COVID-19 pandemic and the height of the “shelter-in-place” orders.

## 5. Conclusions

The COVID-19 pandemic has had a significant effect on maternal prenatal cannabis use resulting in increased rates, especially for pregnant individuals with comorbid pre-conception depression and anxiety. Individuals with depression and/or anxiety who are considering pregnancy should be provided appropriate evidence-based mental health interventions. Healthcare systems should also target these individuals as well as those early in pregnancy with a recent history of depression and/or anxiety for education about the potential harms of prenatal cannabis use to decrease the overall number of exposed pregnancies. Continued monitoring and appropriate interventions for prenatal cannabis use specifically among pregnant individuals with pre-conception depression and/or anxiety during the COVID-19 pandemic is important for ensuring positive maternal and child health outcomes.

## Author contributions

Concept and design: Lyndsay Avalos. Acquisition, analysis, or interpretation of data: Lyndsay A. Avalos, G. Thomas Ray, Sara R. Adams, Monique Does, Stacey E. Alexeeff, Kelly C. Young-Wolff. Drafting of Manuscript: Lyndsay A. Avalos, Critical revision of manuscript for important intellectual content: G. Thomas Ray, Stacey E. Alexeeff, Sara R. Adams, Monique Does, Deborah Ansley, Lue-Yen Tucker, Amy Conway, Allison Ettenger, Nancy Goler, Kelly C. Young-Wolff. Statistical Analysis: G. Thomas Ray. Obtained funding: Lyndsay A. Avalos and Kelly C. Young-Wolff. Administrative, technical or material support: Deborah Ansley, MD, Lue-Yen Tucker, Amy Conway, Allison Ettenger, Nancy Goler. All authors read and approved this manuscript.

## Conflicts of interest

None.

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## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.jadr.2022.100432](https://doi.org/10.1016/j.jadr.2022.100432).

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