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Modes of Preconception Cannabis Use and Prevalence of Cannabis Use Disorder

Kelly C. Young-Wolff[1,2], Catherine A. Cortez[1], Sara R. Adams[1], Alisa A. Padon[3], Judith J. Prochaska[4], Qiana L. Brown[5], Aurash J. Soroosh[3], Cynthia I. Campbell[1,2], Monique B. Does[1], Deborah Ansley[6], Carley Castellanos[6], Asma H. Asyyed[6], Andrea Green[7], & Joshua R. Nugent[1]

[1]Division of Research, Kaiser Permanente Northern California
[2]Department of Psychiatry and Behavioral Sciences, University of California, San Francisco
[3]Public Health Institute
[4]Stanford Prevention Research Center, Stanford University
[5]School of Social Work, Rutgers, The State University of New Jersey
[6]Regional Offices, Kaiser Permanente Northern California
[7]Sacramento Medical Center, Kaiser Permanente Northern California

ABSTRACT

Objective: This cross-sectional study examined associations between modes of cannabis use (smoke, vape, edibles, and/or dabs) during the year before pregnancy and cannabis use disorder (CUD). **Method:** Patients were universally screened for substance use at entrance to prenatal care in an integrated healthcare delivery system (January 2020-July 2024). CUD diagnoses were ascertained from ICD-10 codes in electronic health records during the year before pregnancy. At entrance to prenatal care, patients self-reported frequency of cannabis used during the year before pregnancy (monthly or less, weekly, daily, none) and modes of use during the year before pregnancy (smoke, vape, edibles, dabs). Mode was categorized as no cannabis use, only smoking, only vaping, only dabbing, only edibles, or multiple modes. **Results:** Of 159,270 pregnancies among 130,712 women (mean age of 31.8 [*SD* = 5.2]), 16.6% used cannabis during the year before pregnancy (4.4% only smoked, 1.0% only vaped, 0.1% only dabbed, 3.8% only used edibles, and 7.2% used multiple modes); 908 (0.6%) had a CUD diagnosis in the year before pregnancy. Compared to no cannabis use, use of multiple modes was associated with the greatest CUD prevalence (adjusted prevalence ratio, aPR:11.11, 95% CI: 9.09-13.58), followed by only smoking (aPR:10.10, 95% CI: 8.11-12.58), only dabbing (aPR: 8.99, 95% CI: 3.98-20.30), only vaping (aPR: 5.03, 95% CI:3.04-8.33), and only using edibles (aPR:3.21, 95% CI: 2.15-4.79). Comparing modes, only smoking was associated with greater CUD than only vaping (aPR 2.01, 95% CI: 1.22-3.30) and only using edibles (aPR 3.15, 95% CI: 2.11-4.70); and only dabbing was associated with greater CUD prevalence than only using edibles (aPR 2.80, 95% CI: 1.15-6.82). **Conclusions:** Use of multiple cannabis modes and use of smoked or dabbed modes, compared with edibles or vaping, were associated with a higher prevalence of preconception CUD.

Key words: marijuana; cannabis; pregnancy; smoke; vape; edible; dab; cannabis use disorder

Prenatal cannabis use is associated with increased risk of adverse maternal (gestational hypertension, preeclampsia) and neonatal (preterm birth, low birth weight, neonatal intensive care unit admission) outcomes (Lo et al., 2024; Young-Wolff et al., 2024), and US medical organizations advise against prenatal cannabis use (Braillon & Bewley, 2018). Yet, rates are

Corresponding Author: Kelly C. Young-Wolff, PhD, MPH, Division of Research, Kaiser Permanente Northern California. 4480 Hacienda Drive, Pleasanton, California 94588. Email: Kelly.c.young-wolff@kp.org

increasing among pregnant and reproductive-aged women (Brown et al., 2017; Meinhofer et al., 2022; Volkow et al., 2019) corresponding with increasing legalization, normalization, accessibility, and perceptions of safety. Pregnant women who use cannabis often perceive it as low-risk or less harmful than prescription medications and report using cannabis to help cope with pregnancy-related medical and mental health symptoms (Bayrampour et al., 2019; Chang et al., 2019; Foti et al., 2023). Nearly all women who report prenatal cannabis use also report preconception use (Young-Wolff et al., 2019), highlighting the importance of early prevention and intervention even before conception. Those with more frequent preconception use are at increased risk of prenatal cannabis use (Pike et al., 2021), and those with a preconception cannabis use disorder (CUD) may have the hardest time quitting upon becoming pregnant.

Prior studies in non-pregnant populations suggest that mode of cannabis use can influence both exposure and health effects, with inhaled modes producing higher peak THC concentrations and greater subjective effects than oral ingestion, features that may be associated with greater risk for problematic use and dependence (Barrington-Trimis et al., 2020; Borodovsky et al., 2016; Newmeyer et al., 2017; Russell et al., 2018; Spindle et al., 2018). Further, studies suggest that use of multiple cannabis modes is related to more cannabis-related harms and greater dependence than use of a single mode (Swan et al., 2021). However, studies have primarily focused on any preconception use or frequency of use, and have not examined how preconception modes relate to CUD (Leng et al., 2023; Young-Wolff et al., 2025). Understanding how different preconception modes of cannabis use are associated with CUD is important for improving prevention and early intervention programs.

Using data from a large, integrated healthcare delivery system with universal screening for preconception cannabis use at entrance to prenatal care, we addressed this gap in knowledge by testing whether modes and frequency of preconception cannabis use are associated with preconception CUD.

METHODS

Setting and Study Design

Kaiser Permanente Northern California (KPNC) is an integrated healthcare delivery system serving 4.6 million members who are similar to the insured Northern California population. KPNC Institutional Review Board approved this cross-sectional, observational study with a waiver of informed consent. STROBE reporting guidelines were followed.

Sample

We used KPNC electronic health record (EHR) data to identify pregnancies starting from January 1, 2020, through July 31, 2024. Eligibility criteria included ≥ 10 months of KPNC membership in the year before pregnancy, attendance of at least one prenatal visit, a recorded address to determine neighborhood deprivation as a covariate, and complete prenatal screening questionnaire data with non-missing responses for the questions assessing cannabis use frequency and mode. Individuals could contribute multiple pregnancies to the analysis (eFigure 1).

Measures

CUD in the year before pregnancy was identified using ICD-10 diagnostic codes for cannabis abuse, dependence, or unspecified cannabis-related disorders (F12*, excluding remission codes), as documented by clinicians during clinical care (eMethods 1).

Individuals were universally screened for cannabis use frequency during the year before pregnancy (daily, weekly, monthly or less, no use) at entrance to prenatal care (~5-8 weeks gestation). Individuals who self-reported any cannabis use in the year before pregnancy were asked to select all modes of cannabis they had used during that period (smoke, vape, edible, topical, dab, and/or other, write-in), rather than their preferred or most commonly used mode (eMethods 2). Topical use was excluded from analyses because topical application results in minimal THC absorption relevant to other modes and are unlikely to contribute to CUD (Hess et al., 2017; Varadi et al., 2023). Write-in responses were recoded to the appropriate mode categories where applicable. We created a 6-level categorical cannabis exposure (no use, only smoking, only

vaping, only dabbing, only edibles, multiple modes); multiple modes use was defined as endorsement of two or more non-topical modes at any frequency during the year before pregnancy.

Sociodemographic, pregnancy-related, and substance use-related characteristics included age at pregnancy onset in years (< 18, 18 - 26, 27 - 34, 35 or older), race and ethnicity (Hispanic, and Non-Hispanic Asian, Black, White, Multiple, other, or unknown), neighborhood deprivation index (Messer et al., 2006; NDI; categorized into quartiles), and parity (none, 1, 2 or more pregnancies). Alcohol and tobacco use were based on any self-reported use during the year before pregnancy at entrance to prenatal care or any self-reported use during routine outpatient care screenings during the year before pregnancy. Non-CUD substance use disorders in the year before pregnancy were identified using ICD-10 diagnosis codes (alcohol use disorder: F10.1*, F10.2*, F10.9*; opioid use disorder: F11*; stimulant use disorder: F15*, F14*; tobacco use disorder: F17*, Z71.6).

Statistical Analysis

We described sociodemographic, pregnancy-, substance use-, and cannabis use-related characteristics among pregnancies overall and by CUD diagnosis in the year before pregnancy. Modified Poisson regression with robust standard errors was used to estimate adjusted prevalence ratios for CUD, as this approach provides interpretable risk estimates and avoids inflation associated with odds ratios (Zou, 2004; Zou & Donner, 2013). The primary analysis implemented the 6-level categorical cannabis exposure (no use, only smoking, only vaping, only dabbing, only edibles, multiple modes). As a post-hoc analysis, we then calculated the estimated marginal means from our primary model and performed pairwise comparisons of CUD by mode. The secondary analysis implemented an 11-level categorical cannabis exposure to ensure frequency of cannabis use was accurately attributed to the mode exclusively used among those who reported single mode use (only smoking – daily or weekly, only smoking – monthly or less, only vaping – daily or weekly, etc.).

We conducted a post-hoc analysis for the secondary model to examine pairwise comparisons of CUD stratified by frequency of use with adjusted p-values using a false discovery rate (FDR) correction. Models employed robust standard errors to account for those with multiple pregnancies, clustering on the pregnant individual. Adjustment variables included age at pregnancy onset, race and ethnicity, NDI quartile, parity, alcohol and tobacco use in the year before pregnancy, and non-CUD substance use disorder in the year before pregnancy. Adjusted prevalence ratios (aPRs) with 95% CIs were reported. Analyses were conducted using R software (version 4.5.1). Two-sided p - values < .05 were considered statistically significant.

RESULTS

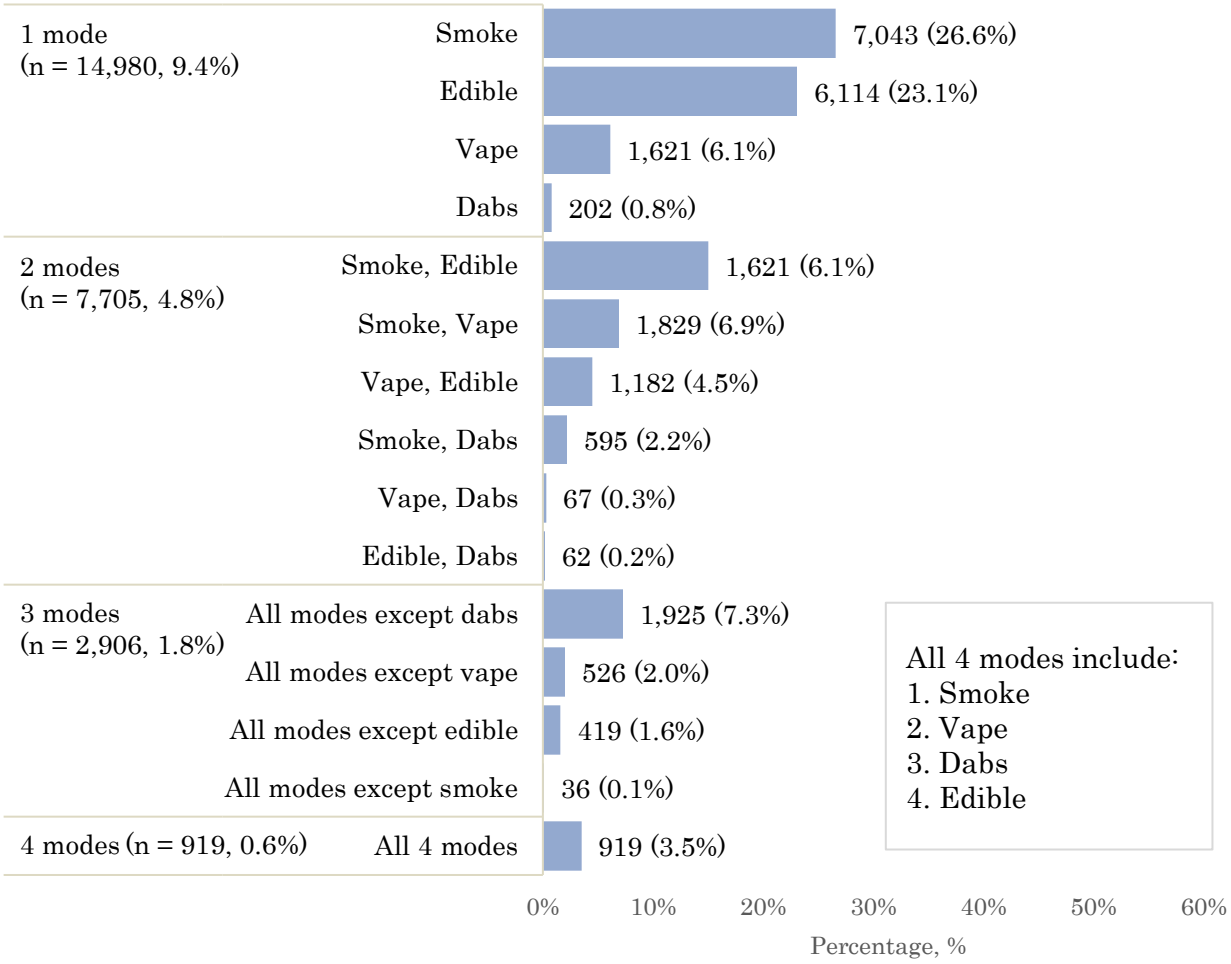
Of 159,270 pregnancies, 908 (0.6%) had a documented CUD diagnosis in the previous year. The sample had a mean (*SD*) age of 31.8 (5.2) years; 28.7% were Hispanic, 26.5% were non-Hispanic Asian, 5.9% were non-Hispanic Black, 33.8% were non-Hispanic White, and 5.1% were multiple, other, or unknown race and ethnicity. Overall, 16.6% reported any cannabis use during the year before pregnancy (8.5% monthly or less, 3.8% weekly, and 4.4% daily). Smoking was the most common mode (10.8%), followed by edibles (9.3%), vape (5.0%), and dabs (1.8%); 9.4% reported using one mode and 7.2% reported using more than one mode (Table 1). Combinations of modes are presented in Figure 1; 68.2% reported alcohol use in the year before pregnancy, 7.5% reported tobacco use in the year before pregnancy, and 1.8% were diagnosed with a non-CUD substance use disorder in the year before pregnancy.

Table 1. *Pregnancy Characteristics Overall and by Cannabis Use Disorder Diagnosis in the Year Before Pregnancy*

Pregnancy characteristics	Overall *N* = 159,270	Cannabis use disorder diagnosis in the year before pregnancy *N* (Column %) Yes *N* = 908 (0.6%)	No *N* = 158,362 (99%)
Any cannabis use in the year before pregnancy	26,510 (16.6%)	677 (74.6%)	25,833 (16.3%)
Maternal age at pregnancy onset, mean (*SD*)	31.8 (5.2)	27.1 (5.9)	31.8 (5.2)
Maternal age at pregnancy onset, group			
<18	515 (0.3%)	23 (2.5%)	492 (0.3%)
18-26	19,438 (12.2%)	379 (41.7%)	19,059 (12.0%)
27-34	90,424 (56.8%)	397 (43.7%)	90,027 (56.8%)
35+	48,893 (30.7%)	109 (12%)	48,784 (30.8%)
Maternal race and ethnicity			
Hispanic	45,696 (28.7%)	317 (34.9%)	45,379 (28.7%)
Non-Hispanic			
Asian	42,260 (26.5%)	46 (5.1%)	42,214 (26.7%)
Black	9,376 (5.9%)	186 (20.5%)	9,190 (5.8%)
White	53,870 (33.8%)	320 (35.2%)	53,550 (33.8%)
Multiple, other, or unknown[a]	8,068 (5.1%)	39 (4.3%)	8,029 (5.1%)
Neighborhood deprivation index, quartile			
Q1: least deprivation	34,003 (21.3%)	83 (9.1%)	33,920 (21.4%)
Q2	44,063 (27.7%)	200 (22.0%)	43,863 (27.7%)
Q3	45,879 (28.8%)	261 (28.7%)	45,618 (28.8%)
Q4: most deprivation	35,325 (22.2%)	364 (40.1%)	34,961 (22.1%)
Frequency of cannabis use in the year before pregnancy			
Never	132,760 (83.4%)	231 (25.4%)	132,529 (83.7%)
Monthly or less	13,515 (8.5%)	149 (16.4%)	13,366 (8.4%)
Weekly	6,000 (3.8%)	166 (18.3%)	5,834 (3.7%)
Daily	6,995 (4.4%)	362 (39.9%)	6,633 (4.2%)
Mode of cannabis use in the year before pregnancy			
None	132,760 (83.4%)	231 (25.4%)	132,529 (83.7%)
Smoke	17,226 (10.8%)	608 (67.0%)	16,618 (10.5%)
Vape	7,998 (5.0%)	226 (24.9%)	7,772 (4.9%)
Dab	2,826 (1.8%)	181 (19.9%)	2,645 (1.7%)
Edible	14,734 (9.3%)	268 (29.5%)	14,466 (9.1%)
Multiple modes	11,530 (7.2%)	366 (40.3%)	11,164 (7.0%)
Total count of cannabis modes in the year before pregnancy			
None	132,760 (83.4%)	231 (25.4%)	132,529 (83.7%)
1	14,980 (9.4%)	311 (34.3%)	14,669 (9.3%)
2	7,705 (4.8%)	186 (20.5%)	7,519 (4.7%)
3	2,906 (1.8%)	120 (13.2%)	2,786 (1.8%)
4	919 (0.6%)	60 (6.6%)	859 (0.5%)
Parity			
0	59,890 (37.6%)	354 (39.0%)	59,536 (37.6%)
1	62,398 (39.2%)	325 (35.8%)	62,073 (39.2%)
>=2	36,982 (23.2%)	229 (25.2%)	36,753 (23.2%)
Alcohol use in the year before pregnancy	108,674 (68.2%)	612 (67.4%)	108,062 (68.2%)
Tobacco use in the year before pregnancy	11,873 (7.5%)	349 (38.4%)	11,524 (7.3%)
Substance use disorder in the year before pregnancy	2,906 (1.8%)	341 (37.6%)	2,565 (1.6%)

Note. [a]Multiple or other race and ethnicity includes American Indian, Alaska Native, Pacific Islander, Native Hawaiian, and multiracial individuals.

Figure 1. *Combinations of Modes Among Those Who Self-Reported Cannabis Use in the Year Before Pregnancy (N = 26,510)*



Association of modes of cannabis use with CUD. Compared with individuals reporting no cannabis use in the year before pregnancy, the prevalence of CUD was highest among those reporting use of multiple modes (aPR 11.11, 95% CI: 9.09-13.58) followed by those who only smoked (aPR 10.10, 95% CI: 8.11-12.58), only dabbed (aPR 8.99, 95% CI: 3.98-20.30), only vaped (aPR 5.03, 95% CI: 3.04-8.33), and only used edibles (aPR 3.21, 95% CI: 2.15-4.79; Table 2, Model 1). In post-hoc pairwise analyses, individuals who used multiple modes had higher CUD prevalence than those who only used edibles (aPR 3.47, 95% CI: 2.35-5.12) or only vaped (aPR 2.21, 95% CI: 1.36-3.59).

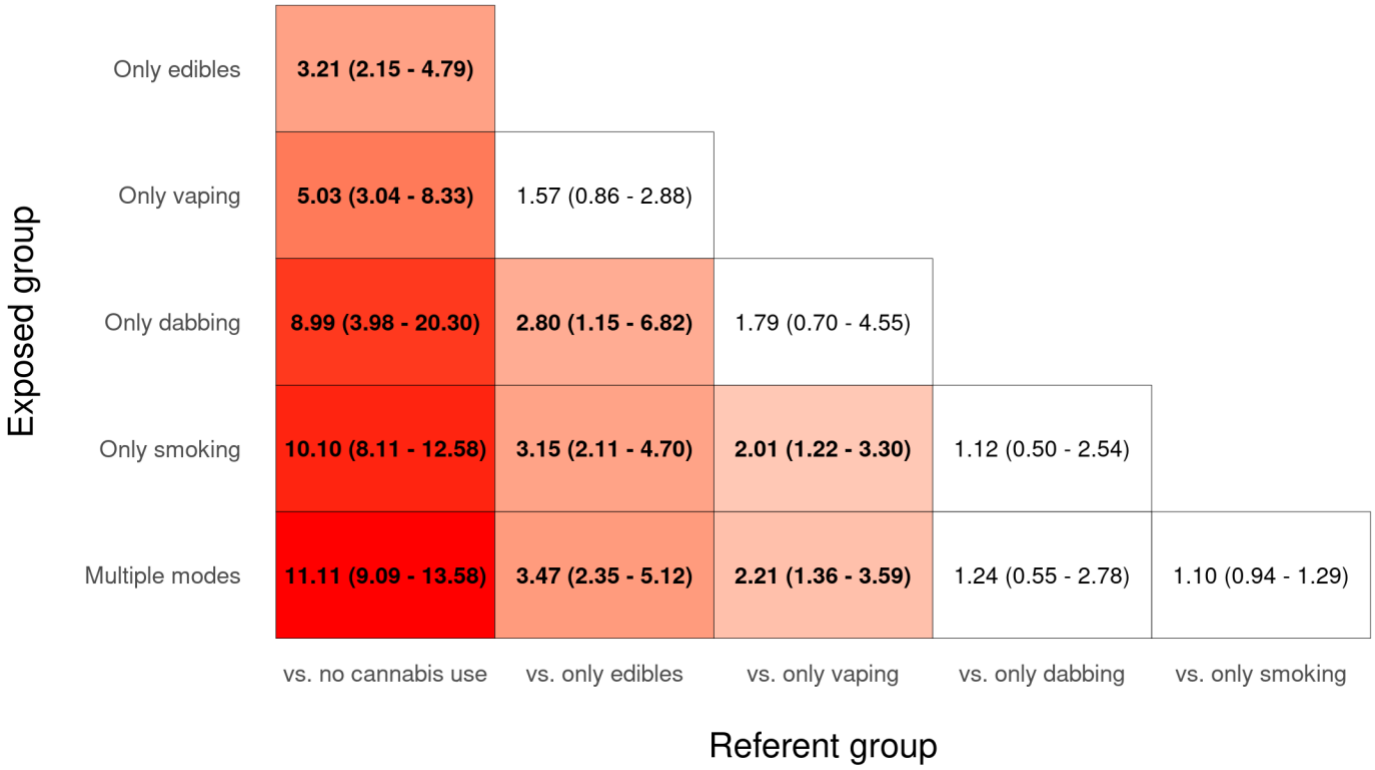
Table 2. *Association of Modes of Cannabis Use with Cannabis Use Disorder in the Year Before Pregnancy (N = 159,270)*

	Cannabis use disorder diagnosis in the year before pregnancy						
		Model 1.[a] Mode (all frequencies)			Model 2.[a] Mode stratified by frequency of use		
Mode of use	*N* (%)	aPR (95%CI)	*p* - value	*N* (%)		aPR (95%CI)	*p* - value
None	132,760 (83.4%)	Reference	–	132,760 (83.4%)	–	Reference	–
Only smoking	7,043 (4.4%)	**10.10 (8.11, 12.58)**	**<0.001**	3,694 (2.3%)	Monthly or less	**7.22 (5.40, 9.67)**	**<0.001**
				3,349 (2.1%)	Daily or weekly	**12.42 (9.76, 15.79)**	**<0.001**
Only vaping	1,621 (1.0%)	**5.03 (3.04, 8.33)**	**<0.001**	600 (0.4%)	Monthly or less	**3.88 (1.89, 7.95)**	**<0.001**
				1,021 (0.6%)	Daily or weekly	**7.05 (3.55, 14.00)**	**<0.001**
Only dabbing	202 (0.1%)	**8.99 (3.98, 20.30)**	**<0.001**	124 (0.1%)	Monthly or less	3.11 (0.29, 33.22)	0.347
				78 (0.0%)	Daily or weekly	**13.98 (6.35, 30.80)**	**<0.001**
Only edibles	6,114 (3.8%)	**3.21 (2.15, 4.79)**	**<0.001**	1,260 (0.8%)	Monthly or less	**2.57 (1.55, 4.25)**	**<0.001**
				4,854 (3.0%)	Daily or weekly	**5.14 (2.79, 9.49)**	**<0.001**
Multiple modes	11,530 (7.2%)	**11.11 (9.09, 13.58)**	**<0.001**	7,317 (4.6%)	Monthly or less	**6.48 (4.78, 8.77)**	**<0.001**
				4,213 (2.6%)	Daily or weekly	**13.24 (10.73, 16.35)**	**<0.001**

Note. Abbreviations: aPR – adjusted prevalence ratio, CI – confidence interval. [a]Models were adjusted for age, race and ethnicity, neighborhood deprivation index (quartile), parity, tobacco use in the year before pregnancy, and non-CUD substance use disorder in the year before pregnancy. Bolded values indicate statistical significance at a threshold of $p < .05$.

Among individuals reporting a single mode, CUD prevalence was higher among those who only smoked compared with those who only used edibles (aPR 3.15, 95% CI: 2.11-4.70) or only vaped (aPR 2.01, 95% CI: 1.22-3.30), and higher among those who only dabbed compared with those who only used edibles (aPR 2.80, 95% CI: 1.15-6.82; Figure 2).

Figure 2. *Adjusted prevalence ratios (aPRs) and 95% confidence intervals (CI) for pairwise comparisons of cannabis use disorder risk by modes of cannabis use (N = 159,270)*



Note. Statistically significant associations ($p < 0.05$) are indicated by boldface text and a red color gradient representing prevalence ratios from light red (lower prevalence ratio) to deep red (higher prevalence ratio).

Similar patterns were found after stratifying by frequency of use, with higher CUD prevalence among those who used multiple modes or smoked cannabis at both monthly or less and daily or weekly frequencies, and lower prevalence among those who only used edibles or only vaped. Compared to no cannabis use, CUD was elevated among those who used multiple modes (monthly or less use aPR 6.48, 95% CI: 4.78-8.77; daily or weekly use aPR 13.24, 95% CI: 10.73-16.35), only smoked (monthly or less use aPR 7.22, 95% CI: 5.40-9.67; daily or weekly use aPR 12.42, 95% CI: 9.76-15.79), only vaped (monthly or less use aPR 3.88, 95% CI: 1.89-7.95; daily or weekly use aPR 7.05, 95% CI: 3.55-14.00), and only used edibles (monthly or less use aPR 2.57, 95% CI: 1.55-4.25; daily or weekly use aPR 5.14, 95% CI: 2.79-9.49). Higher CUD was observed among those who only dabbed on a daily or weekly basis (aPR 13.98, 95% CI: 6.35-30.80) but not among those who reported monthly or less dab use (aPR 3.11, 95% CI: 0.29-33.22; Table 2, Model 2).

Consistent with these patterns, pairwise comparisons of those reporting daily or weekly use demonstrated higher CUD prevalence among those who only smoked vs only used edibles (aPR 2.41, 95% CI: 1.30-4.49), only dabbed vs only used edibles (aPR 2.72, 95% CI: 1.02-7.25), and used multiple modes vs only used edibles (aPR 2.58, 95% CI: 1.40-4.74; eFigure 2). In pairwise comparisons among those reporting monthly or less use, CUD was higher among those who only smoked vs only used edibles (aPR 2.81, 95% CI: 1.64-4.81) and used multiple modes vs only used edibles (aPR 2.52, 95% CI: 1.47-4.34; eFigure 3).

DISCUSSION

The preconception period is a critical stage of the reproductive life course, given its strong influence on the health of both the mother and baby during pregnancy. In this large, cross-sectional study of pregnant women universally screened for preconception cannabis use, all modes of cannabis use (smoke, vape, edibles, dabs, and multiple modes) during the year before pregnancy were associated with higher prevalence of preconception CUD. While CUD

generally increased with greater frequency of preconception use, associations were also observed among those who reported monthly or less use, with the exception of only dabbing monthly or less. Notably, CUD prevalence was highest among those who used multiple modes or who smoked or dabbed cannabis, compared with edibles or vaping. Findings indicate that mode of cannabis use is associated with CUD prevalence and highlight potential heterogeneity that may be overlooked when examining prevalence or frequency of use alone.

Results complement studies of adolescents and the general population indicating that use of multiple modes is associated with greater CUD risk (Baggio et al., 2014; Dunbar et al., 2025; Knapp et al., 2019). Findings highlight the importance of screening for both frequency and mode of cannabis use during standard women's health care and suggest that women who use multiple modes, smoke, or dab may be at greatest risk for CUD and might benefit most from further assessment, education, and possible intervention. Public health campaigns and clinical counseling efforts may benefit from messages that go beyond focusing solely on frequency of use to also address mode of administration, emphasizing that inhaled and multimode use may be associated with greater risk for CUD in the preconception period.

Study strengths include a sociodemographically diverse sample of pregnant women universally screened for preconception cannabis use alongside clinician-documented ICD-10 diagnoses of preconception CUD. The study is limited in that the sample comprised pregnant individuals in KPNC, and findings may not be generalizable to non-pregnant individuals, those without insurance, or those outside of California. Preconception cannabis use was reported at prenatal intake, whereas CUD was identified via ICD-10 codes documented during clinical care in the year before pregnancy; both measures are likely underestimated in EHR data. Notably, 25.4% of those with a CUD diagnosis reported no cannabis use during the year before pregnancy, whereas only 2.6% of those who self-reported cannabis use during the year before pregnancy were diagnosed with CUD. This discrepancy likely reflects underreporting of cannabis use in prenatal care and differences between clinician-documented diagnoses and self-reported substance use. Although we adjusted for tobacco use, the elevated prevalence of CUD among those who smoked cannabis could partly reflect simultaneous co-use of tobacco and cannabis within the same product (e.g., via blunts), which has been shown to increase the likelihood of developing CUD. Finally, given the temporal ambiguity inherent to cross-sectional studies, we are unable to determine whether mode of cannabis use predicts CUD or vice versa. Future longitudinal studies are needed that assess modes of cannabis use and the development of preconception CUD over time.

Conclusions

This large, population-based cross-sectional study of pregnant individuals universally screened for preconception cannabis use found that prevalence of CUD varied not only by use frequency but also by mode of administration. CUD prevalence was highest among those who smoked, dabbed, or used multiple modes, and associations were observed even among those who reported using monthly or less. Results indicate that certain modes of use may signal greater risk for CUD and prevention efforts may benefit from addressing these patterns of use. Because many pregnancies are unintended, patients may not be prepared to stop using cannabis once they become pregnant. Findings highlight the importance of screening for both cannabis mode and frequency during routine gynecological visits. Preconception counseling should include education on the risks of prenatal cannabis use, encourage patients to reflect on how challenging it may be to quit, and recommend treatment for those with CUD to help minimize or discontinue use before pregnancy. Public health messaging that recognizes that the risks associated with cannabis use may vary with different mode of use may be warranted.

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