Research Article

Cannabis Use Transitions During Early Pregnancy

Cannabis
2026

researchmj.org
10.26828/cannabis/2026/000353

Alyssa F. Harlow[1,2], Jessica L. Barrington-Trimis[1,2], Ruth J. Geller[3], Kenneth J. Rothman[3], Amelia K. Wesselink[3], & Lauren A. Wise[3]
[1]Department of Population and Public Health Sciences, University of Southern California
[2]Institute for Addiction Science, University of Southern California
[3]Department of Epidemiology, Boston University School of Public Health

ABSTRACT

Objective: Cannabis use during pregnancy is increasing; however, the prevalence and correlates of cannabis use transitions between preconception and early pregnancy (e.g., persistent use, new uptake, discontinuation) are understudied. **Method:** Data were from a prospective cohort of United States and Canadian residents trying to conceive who completed online questionnaires during preconception (every 2 months for up to 12 months) and early pregnancy (<12 weeks gestation). Among 9,200 participants who conceived between 2013-2025, we examined associations of sociodemographic characteristics, preconception behaviors, and nausea and vomiting during pregnancy (NVP) with: a) any past-month cannabis use in pregnancy; b) persistent cannabis use (vs. discontinuation) among participants using cannabis during preconception; and c) new uptake of cannabis (vs. persistent nonuse) among participants not using cannabis during preconception. **Results:** In the full sample (n = 9,200), 284 (3.1%) reported persistent cannabis use, 911 (9.9%) discontinued use, 45 (0.5%) reported new uptake, and 7,960 (86.5%) reported persistent nonuse between preconception and early pregnancy. Among individuals using cannabis during preconception (n = 1,194), 23.8% continued use in pregnancy; among preconception daily cannabis users (n = 8,006), 54.8% continued use in pregnancy. Lower education and income, being unmarried, age <25 years, and history of diagnosed depression and/or anxiety were associated with any cannabis use, persistent use, and new uptake during pregnancy. Preconception alcohol and cigarette use were associated with any cannabis use but not persistent use in pregnancy. NVP was inversely associated with any cannabis use, persistent use, and new uptake during pregnancy. **Conclusions:** Findings highlight a need for cannabis cessation interventions during preconception and early pregnancy, particularly for reproductive-aged individuals with comorbid mental health issues who use cannabis frequently.

Key words: preconception; cohort studies; cannabis; cannabis use transitions

As cannabis legalization and commercialization expand across the United States (US), cannabis use during pregnancy has become increasingly prevalent (Hayes et al., 2023; Volkow et al., 2019; Young-Wolff et al., 2024). Between 2002 and 2020, the prevalence of cannabis use among US pregnant individuals increased from 6.3% to 16.0% during the first trimester, 1.9% to 4.2% in the second trimester, and 2.0% to 4.7% in the third trimester (Hayes et

Corresponding Author: Alyssa F. Harlow, PhD, MPH. Department of Population and Public Health Science, University of Southern California, 1845 N Soto Street. Los Angeles, California, 90032. Phone: (612) 760-4181. Email: afharlow@usc.edu

al., 2023). In contrast, use of alcohol during pregnancy is declining (Hasin et al., 2019). The American College of Obstetricians and Gynecology encourages discontinuation of cannabis use among pregnant women and those contemplating pregnancy in light of insufficient data on the effects of cannabis use on perinatal outcomes ("Committee Opinion No. 722," 2017). Several studies have shown associations between prenatal cannabis use and adverse perinatal outcomes, including gestational diabetes, preterm birth, low birth weight, and small for gestational age birth (Conner et al., 2016; Pan et al., 2024; Prewitt et al., 2023). Given the potential adverse effects of preconception and prenatal cannabis use, it is a high priority to develop an evidence base on patterns of cannabis use among individuals before and during pregnancy to inform tailored interventions and clinical recommendations.

There are several reasons why individuals may use cannabis during pregnancy. Reasons for use include perceptions that cannabis use eases pregnancy symptoms such as nausea and vomiting (Chang et al., 2019), self-medication for stress or mental health symptoms (Besse et al., 2023; Chang et al., 2019; Mark et al., 2017), and increasing normalization and low perceived harm of cannabis use in pregnancy (Ko et al., 2015; Mark et al., 2017; Micalizzi et al., 2024). Studies have also identified factors correlated with prenatal cannabis use, including younger age, lower socioeconomic status (SES), other drug use, and poor mental health (Corsi et al., 2019; Ko et al., 2015; Mark et al., 2016; Taylor et al., 2021; Young-Wolff et al., 2019, 2020). However, most studies on cannabis use during pregnancy employ cross-sectional or retrospective designs among individuals who are currently pregnant or after birth using recall methods. Such designs limit the ability to examine prevalence and correlates of key behavioral transitions between the preconception period and pregnancy, such as persistent use, discontinuation, or new uptake after conception. Identifying preconception correlates of continued cannabis use in early pregnancy could aid clinicians in targeting cannabis cessation interventions by identifying populations at elevated risk of cannabis use in pregnancy. Such information is also valuable for researchers seeking to evaluate the effect of prenatal cannabis use on birth outcomes by producing data on key confounders that temporally precede and are associated with cannabis use in pregnancy.

Studies have examined factors predicting cigarette smoking and alcohol continuation or discontinuation during pregnancy (Harrison & Sidebottom, 2009; Liu et al., 2016; Riaz et al., 2018). However, there is comparatively little evidence on cannabis use transitions (Allen et al., 2020; Mark et al., 2017; Pike et al., 2021), including whether the probability of continuation or discontinuation of cannabis is similar to that for alcohol and cigarettes (Forray et al., 2015). To our knowledge, three studies in the past ten years have examined factors associated with continuation or cessation of cannabis in pregnancy (Allen et al., 2020; Mark et al., 2017; Pike et al., 2021). These studies found that among participants who reported using cannabis before pregnancy, between 34-59% continued cannabis use in some capacity during pregnancy. However, all three studies were cross-sectional survey designs in which pregnant participants recalled behaviors before pregnancy. This design increases the potential for recall bias when examining risk factors associated with continued cannabis use (i.e., differential misclassification of prior behaviors by cannabis use in pregnancy; Coughlin, 1990). Additionally, prior studies focused on individuals who used cannabis before pregnancy and did not examine whether risk factors for cannabis continuation are similar to risk factors for new uptake among those who did not use cannabis during preconception. As cannabis use and commercialization continue to grow in North America, there is a need for updated evidence on cannabis use in pregnancy, particularly from prospective studies that differentiate clinically relevant cannabis use patterns to identify sub-groups during preconception who may be at greatest risk for continued use or new uptake during early pregnancy.

In the current study, we prospectively examined patterns of cannabis use during preconception and into early pregnancy among North American pregnancy planners enrolled in a web-based preconception cohort study. We also compared behavioral transition rates of cannabis with cigarette and alcohol use. We additionally examined the associations of sociodemographic characteristics, preconception behaviors, and

nausea and vomiting during pregnancy (NVP, i.e., 'morning sickness') with cannabis use into early pregnancy. We estimated cannabis use risk among the full sample of participants (including those who did and did not use cannabis in preconception) and stratified by preconception cannabis use status to compare risk factors for any cannabis use in pregnancy with risk factors for continued cannabis use and new uptake in pregnancy.

METHODS

Data Source and Participants

We analyzed data from the Pregnancy Study Online (PRESTO) study, an ongoing web-based preconception prospective cohort study of individuals planning a pregnancy and living in North America (described previously; Wise et al., 2015). PRESTO participants are aged 21-45 years, were assigned female at birth, reside in the US or Canada, are actively attempting to conceive without fertility treatment, and are in a relationship with one male partner. Upon enrollment, participants complete a baseline questionnaire on medical history and sociodemographic and lifestyle factors (e.g., substance use, diet, physical activity) and then complete bimonthly follow-up questionnaires for up to 12 months or until a pregnancy is reported. On bimonthly follow-up questionnaires, participants report whether they are currently pregnant, dates of recent menstrual periods, and (if applicable) how their conception was confirmed (e.g., home pregnancy test, physician-assisted blood test). Pregnant participants then complete two additional questionnaires in early (<12 weeks gestation) and late pregnancy (~32 weeks gestation). PRESTO was approved by the Boston University Medical Campus Institutional Review Board and all participants provided informed consent.

The current study used data from the preconception baseline questionnaire, the most recent follow-up questionnaire completed before conception (hereafter referred to as the "preconception questionnaire"), and the early pregnancy questionnaire. Eligible participants included those who reported a pregnancy during follow-up and completed the early pregnancy questionnaire. Between June 2013 and May 2025, 11,770 PRESTO participants conceived during the study period, among whom 9,200 completed the early pregnancy questionnaire. Participants who completed the pregnancy questionnaire (vs. did not complete) had slightly higher education and income but similar preconception cannabis use frequency (Supplemental Table 1).

Measures

Cannabis and other substance use transitions. For the current study, we analyzed cannabis data obtained from the preconception questionnaire and the early pregnancy questionnaire to identify transitions in cannabis use behaviors between preconception and early pregnancy. At both time points, participants self-reported their past-month cannabis use frequency (response options: no use, <1 time per week, 1-3 times per week, 4-6 times per week, every day). Cannabis use transitions were assessed as a four-category variable comprising 'persistent use of cannabis' (any cannabis use during both preconception and early pregnancy), 'discontinuation of cannabis use' (any cannabis use during preconception and no use during early pregnancy), 'new uptake of cannabis use' (no cannabis use during preconception and any cannabis use during early pregnancy), and 'persistent nonuse of cannabis' (no cannabis use during preconception or early pregnancy; Supplemental Figure 1).

Participants also reported past-month alcohol consumption (none, <1 drink/week, 1-6 drinks/week, ≥7 drinks/week) and past-month cigarette smoking (current regular [at least one cigarette/day], current occasional [non-daily], former, never smoker) at both time points. We created similar variables separately for cigarette smoking and alcohol use transitions (i.e., persistent use, discontinuation, new uptake, persistent nonuse).

Sociodemographic characteristics. Participants reported their educational attainment (categorized as ≤12, 13-15, 16, ≥17 years), annual income (categorized as <$50,000, $50,000-$99,999, $100,000-$149,999, ≥$150,000, refused/don't know), and marital status (married, not married) on the baseline questionnaire. We included variables for participant age and partner age at the preconception questionnaire.

Preconception behavioral characteristics. On the preconception questionnaire, participants

reported current perceived stress using the 10-item Perceived Stress scale (PSS-10; continuous score [range 0-40]; Cohen et al., 1983), and history of physician-diagnosed depression (yes/no) and anxiety (yes/no). Physical activity levels were assessed using the International Physical Activity Questionnaire short-form (Craig et al., 2003) and summing metabolic equivalents (METs) for walking, moderate physical activity, and vigorous physical activity (hours/week; continuous variable). Participants also reported on their use of multivitamins or folate/prenatal supplements (yes/no).

Pregnancy Characteristics. Participants reported their gestational age (in weeks) at their first positive pregnancy test. We calculated gestational age (in weeks) at the early pregnancy questionnaire based on the questionnaire completion date and the participant's last menstrual period. Participants also reported on the early pregnancy questionnaire whether they had experienced nausea or vomiting during their current pregnancy (yes/no).

Analysis

We examined the distribution of participants' sociodemographic, preconception, and pregnancy characteristics overall and according to category of cannabis use transition. We then compared the prevalence of cannabis use transitions with the prevalence of alcohol use and cigarette smoking transitions between preconception and early pregnancy. For each substance (cannabis, alcohol, cigarettes), we examined the overall prevalence of each transition category (persistent use, discontinuation, new uptake, persistent nonuse), the prevalence of persistent use and discontinuation among participants who used the substance during preconception, and the prevalence of new uptake and persistent nonuse among participants who did not use the substance during preconception.

We fit a series of regression models to examine preconception correlates of cannabis use during early pregnancy. We used modified Poisson models to estimate probability ratios (PR) and 95% confidence intervals (CI) for the association of each correlate with each binary cannabis use outcome (Zou, 2004). The first set of models examined the associations of sociodemographic (age, partner age, marital status, education, income) and preconception factors (cannabis use frequency, cigarette smoking, alcohol, history of depression/anxiety, current perceived stress, physical activity, prenatal supplements) with probability of any cannabis use during early pregnancy among the full sample of n = 9,200 participants, regardless of cannabis use during preconception. We restricted the second set of models to participants who reported using cannabis (at any frequency) during preconception (n = 1,195) and examined the associations of sociodemographic and preconception factors with probability of persistent use of cannabis during early pregnancy (vs. discontinuation). We restricted the third set of models to participants who reported no cannabis use during preconception (n = 8,005) and examined the association of sociodemographic and preconception factors with probability of new uptake of cannabis during early pregnancy (vs. persistent nonuse). We examined associations with sociodemographic factors in separate unadjusted models, and preconception factors in separate models adjusted for all sociodemographic factors.

Given that treatment of NVP is a commonly cited reason for cannabis use during pregnancy (Metz et al., 2022; Vanderziel et al., 2023; Young-Wolff et al., 2018), we additionally fit regression models examining the associations of NVP during pregnancy with any cannabis use, persistent cannabis use, and new uptake of cannabis in early pregnancy, adjusting for sociodemographic factors. Any NVP during the index pregnancy was self-reported by participants at the time of the early pregnancy questionnaire. To reduce potential misclassification arising from inclusion of participants who were too early in their pregnancy to have experienced NVP, we conducted a sensitivity analysis examining the association of NVP with cannabis use outcomes (any use, persistent use, new uptake) after restricting to participants who were at least 8 weeks' gestation at the time of the early pregnancy questionnaire (when NVP was assessed).

In line with recommendations from the American Statistical Association (Wasserstein & Lazar, 2016), we interpret estimates based on the magnitude of PRs and precision of CIs, rather than relying on null hypothesis testing and p-values. We addressed missing data using

multiple imputation (full conditional specification method) with 10 imputed datasets. Regression models were fit separately by imputation and estimates were pooled across imputations to obtain correct variance estimates. We did not report effect estimates when the number of outcome cases in the exposure or reference group was <5. Data were missing for <1% of participants for all variables except for smoking and cannabis use in pregnancy (2.6% missing). Analyses were conducted in SASv9.4.

RESULTS

Participant Characteristics Overall and by Cannabis Use Transitions

Among 9,200 participants who conceived during follow-up, mean gestational age at completion of the early pregnancy questionnaire was 9.5 weeks and mean gestational age at the index pregnancy test was 4.1 weeks (Table 1).

The mean participant age was 30.5 years and the mean male partner age was 32.3 years, with 92.0% of participants reporting being married, and a majority having ≥17 years of education (51.7%) and an annual income of ≥$100,000 (29.0% $100,000-$149,999; 29.0% ≥$150,000; Table 1). Overall, 13.0% reported any past-month cannabis use in preconception, with 2.0% reporting daily use. Prevalence of current regular cigarette smoking during preconception was 2.3%, and nearly three-quarters of participants (72.5%) reported having at least one alcoholic beverage per week during preconception.

Overall, 284 (3.1%) participants reported persistent use of cannabis both during preconception and during early pregnancy, 910 (9.9%) discontinued cannabis use during early pregnancy after use in preconception, 44 (0.5%) reported new uptake of cannabis use during early pregnancy, and 7,962 (86.5%) reported persistent nonuse of cannabis during both preconception and early pregnancy (Table 1). In descriptive analyses, participants who reported either persistent cannabis use or new uptake of cannabis in pregnancy were less likely than those who discontinued or persistently avoided cannabis to be married, report use of prenatal supplements, and report NVP; they were more likely to have lower education and income, smoke cigarettes, report history of diagnosed depression or anxiety and higher current stress scores, and completed the pregnancy questionnaire slightly earlier in pregnancy.

Table 1. *Characteristics of 9,200 Participants who Conceived During Follow-up (2013-2025)*

		Among Participants Who Used Cannabis in Preconception		Among Participants Who Did Not Use Cannabis in Preconception	
	Overall Sample (*N* = 9,200)	Persistent Use (*N* = 284)	Discontinuation (*N* = 910)	New Uptake (*N* = 44)	Persistent Non-Use (*N* = 7,962)
Sociodemographic Factors	***N*** **(col%)**	**Mean (*SD*) or col%**	**Mean (*SD*) or col%**	**Mean (*SD*) or col%**	**Mean (*SD*) or col%**
Age, mean (*SD*)	30.5 (3.7)	30.3 (4.4)	30.4 (3.5)	30.7 (4.3)	30.5 (3.7)
Partner age, mean (*SD*)	32.3 (4.7)	32.4 (5.5)	32.4 (4.4)	32.5 (5.2)	32.2 (4.7)
Married, *n* (%)	8,468 (92.0%)	76.1%	90.1%	84.1%	92.9%
Years of education, *n* (%)					
≤12	182 (2.0%)	6.0%	2.1%	4.6%	1.8%
13-15	1135 (12.3%)	26.4%	13.5%	27.3%	11.6%
16	3127 (34.0%)	35.2%	33.9%	40.9%	33.9%
≥17	4756 (51.7%)	32.4%	50.6%	27.3%	52.7%
Annual household income (USD), *n* (%)					
<$50,000	903 (9.8%)	21.1%	8.5%	15.9%	9.5%
$50,000-99,999	2755 (30.0%)	31.7%	28.8%	36.4%	30.0%
$100,000-149,999	2666 (29.0%)	28.2%	28.7%	20.5%	29.1%
≥$150,000	2669 (29.0%)	15.9%	32.5%	20.5%	29.1%
Refused/Doesn't know	207 (2.3%)	3.2%	1.5%	6.8%	2.3%

Preconception Factors[a]					
Cannabis use frequency, *n* (%)					
Daily	187 (2.0%)	35.9%	9.3%	0.0%	0.0%
4-6/week	111 (1.2%)	16.2%	7.1%	0.0%	0.0%
1-3/week	192 (2.1%)	22.5%	14.1%	0.0%	0.0%
<1/week	704 (7.6%)	25.3%	69.4%	0.0%	0.0%
Non-use	8006 (87.0%)	0.0%	0.0%	100%	100%
Cigarette smoking, *n* (%)					
Current regular	208 (2.3%)	9.5%	3.3%	6.8%	1.9%
Current occasional	183 (2.0%)	4.9%	4.2%	0.0%	1.7%
Former	958 (10.4%)	23.9%	17.4%	20.4%	9.1%
Never	7851 (85.3%)	61.6%	75.2%	72.7%	87.4%
Alcoholic drinks, *n* (%)					
≥7/week	1093 (11.9%)	18.3%	23.0%	20.4%	10.4%
1-6/week	5579 (60.6%)	61.3%	65.5%	52.3%	60.1%
None	2526 (27.5%)	20.4%	11.5%	27.3%	29.5%
Depression diagnosis, *n* (%)	2286 (24.9%)	43.0%	30.7%	40.9%	23.5%
Anxiety diagnosis, *n* (%)	2630 (28.6%)	47.5%	34.3%	45.4%	27.2%
Perceived stress scale, mean (*SD*)	15.5 (6.0)	17.5 (6.5)	15.9 (6.2)	17.9 (6.8)	15.4 (5.9)
Total MET/hr, mean (*SD*)	32.3 (22.5)	31.2 (22.3)	34.0 (23.5)	33.8 (26.6)	32.1 (22.4)
Prenatal supplements, *n* (%)	8143 (88.5%)	79.9%	86.8%	79.6%	89.1%
Pregnancy Characteristics					
Gestational weeks at pregnancy survey, mean (*SD*)[b]	9.5 (5.2)	8.3 (5.6)	10.0 (5.1)	7.4 (4.9)	9.5 (5.1)
Gestational weeks at positive pregnancy test, mean (*SD*)[c]	4.1 (0.8)	4.2 (1.0)	4.1 (0.7)	4.2 (0.9)	4.1 (0.8)
Nausea, *n* (%)	6,695 (72.8%)	59.9%	77.8%	52.3%	72.8%
Cannabis use frequency, *n* (%)					
Everyday	75 (0.8%)	26.1%	0.0%	2.3%	0.0%
4-6/week	35 (0.4%)	12.0%	0.0%	2.3%	0.0%
1-3/week	69 (0.7%)	20.8%	0.0%	22.7%	0.0%
<1/week	149 (1.6%)	41.2%	0.0%	72.7%	0.0%
No use	8,872 (96.4%)	0%	100%	0%	100%

Note. USD = United States dollars [a]Measured during preconception at most recent cycle before conception. [b]Gestational weeks at survey calculated based on date of early pregnancy survey completion date and date of last menstrual period. Excluded *n* = 97 participants with implausible values. [c]Added to questionnaire in 2017. Missing for 2,340 participants (25%) and not imputed.

Comparison of Cannabis Use Transitions with Cigarette and Alcohol Transitions

Alcohol was the most commonly used substance, with 19.4% of the sample reporting persistent use (vs. 3.1% for cannabis), 53.1% reporting discontinuation (vs. 9.9% for cannabis), 1.4% reporting new uptake in pregnancy (vs. 0.5% for cannabis), and only 26.0% reporting persistent nonuse (vs. 86.5% for cannabis; Table 2). In contrast, cigarette smoking was rare in the overall sample, with 2.0% reporting persistent use, 2.3% discontinuation, 0.2% new uptake, and 95.5% persistent nonuse.

However, among participants who reported smoking cigarettes during preconception, proportions reporting persistent use were high, with 45.8% reporting continued smoking in early pregnancy, compared with 23.8% of continued cannabis use among participants using cannabis in early pregnancy, and 26.8% of continued alcohol use among participants who used alcohol during preconception. Among nonusers in preconception, probability of new uptake was highest for alcohol, with 5.3% of participants who did not use alcohol in preconception reporting new use of alcohol in early pregnancy (vs. 0.6% new uptake of cannabis and 0.2% for cigarettes).

Table 2. *Prevalence of Transition Patterns for Cannabis, Alcohol, and Cigarette Use from Preconception to Early Pregnancy*

	Persistent Use	Discontinuation	New Uptake	Persistent Non-Use
	%	%	%	%
Overall Sample (*N*= 9,200)				
Cannabis	3.1	9.9	0.5	86.5
Alcohol	19.4	53.1	1.4	26.0
Cigarettes	2.0	2.3	0.2	95.5
Among Participants Who Used Substance in Preconception				
Cannabis (*N*= 1,194)	23.8	76.2	-	-
Alcohol (*N*= 6,675)	26.8	73.2	-	-
Cigarettes (*N*= 392)	45.8	54.2	-	-
Among Participants Who Did Not Use Substance in Preconception				
Cannabis (*N*= 8,006)	-	-	0.6	99.4
Alcohol (*N*= 2,525)	-	-	5.3	94.7
Cigarettes (*N*=8,808)	-	-	0.2	99.8

Sociodemographic Factors Associated with Cannabis Use Transitions in Pregnancy

Participant age and partner age >25 years (vs. <25 years) were associated with lower probability of cannabis use in early pregnancy among the full sample (PRs range 0.49-0.63) and of persistent cannabis use (vs. discontinuation) among participants who reported cannabis use during preconception (PRs = 0.32-0.65; Table 3). Participants who were married were also less likely to use cannabis in pregnancy among the full sample (PR = 0.29, 95%CI = 0.23-0.38), to report persistent cannabis use (vs. discontinuation; PR = 0.49, 95%CI: 0.37-0.64), and to report new uptake of cannabis in early pregnancy (PR = 0.41, 95%CI: 0.18-0.91). Lower education (vs. ≥17 years) and lower annual income (vs. ≥$150,000/year) were positively associated with cannabis use in pregnancy among the full sample (PR education range = 1.74-4.74; PR income range = 1.65-3.66) and with persistent use (PR education range = 1.48-2.82; PR income range = 1.78-3.32); PRs were strongest for the lowest categories of income (<$50,000/year) and education (≤12 years). Lower education and income were also associated with greater probability of new uptake, though CIs for income PRs were imprecise and included a range of estimates bracketing the null (e.g., <$50,000 vs. ≥$150,000 PR = 2.36, 95%CI: 0.88-6.34). Additionally, several other PR estimates for new uptake were not reported due to small cell sizes.

Table 3. *Sociodemographic Factors Associated with Cannabis Use in Early Pregnancy*

	Among Full Sample (*n* = 9,200)		Among Participants Who Used Cannabis in Preconception (*n* = 1,194)		Among Participants Who Did Not Use Cannabis in Preconception (*n* = 8,006)	
	Any vs. No Cannabis Use		Persistent Use vs. Discontinuation		New Uptake vs. Persistent Non-use	
Sociodemographic Factor	***N*(%) outcome[a]**	**PR (95%CI)[b]**	***N*(%) outcome[a]**	**PR (95%CI)[b]**	***N*(%) outcome[a]**	**PR (95%CI)[b]**
Age (years)						
<25	29 (6.6)	Ref	28 (45.9)	Ref	1 (0.3)	Ref
25-29	106 (3.3)	0.49 (0.32-0.73)	89 (20.8)	0.44 (0.29-0.68)	17 (0.6)	+
30-34	139 (3.3)	0.49 (0.33-0.72)	121 (22.0)	0.47 (0.31-0.70)	18 (0.5)	+
≥35	54 (4.2)	0.63 (0.40-0.98)	46 (29.9)	0.65 (0.41-1.03)	8 (0.7)	+

Partner age (years)						
<25	16 (6.5)	Ref	13 (59.1)	Ref	3 (1.3)	Ref
25-29	94 (4.0)	0.60 (0.35-1.02)	82 (27.2)	0.45 (0.25-0.81)	12 (0.6)	+
30-34	119 (2.9)	0.44 (0.26-0.74)	105 (19.6)	0.32 (0.18-0.57)	14 (0.4)	+
≥35	99 (3.9)	0.59 (0.35-0.99)	84 (25.1)	0.42 (0.24-0.75)	15 (0.7)	+
Marital status						
Married	253 (3.0)	0.29 (0.23-0.38)	216 (20.9)	0.49 (0.37-0.64)	37 (0.5)	0.41 (0.18-0.91)
Not married	75 (10.3)	Ref	68 (43.0)	Ref	7 (1.2)	Ref
Years of education						
≤12	19 (10.4)	4.74 (2.90-7.75)	17 (47.2)	2.82 (1.67-4.73)	2 (1.4)	+
13-15	87 (7.7)	3.50 (2.63-4.66)	75 (37.8)	2.26 (1.67-3.08)	12 (1.3)	4.56 (2.05-10.1)
16	118 (3.8)	1.74 (1.34-2.27)	100 (24.5)	1.48 (1.12-1.97)	18 (0.7)	2.33 (1.12-4.84)
≥17	104 (2.2)	Ref	92 (16.7)	Ref	12 (0.3)	Ref
Annual household income (USD)						
<$50,000	67 (7.4)	3.66 (2.56-5.25)	60 (43.8)	3.32 (2.25-4.89)	7 (0.9)	2.36 (0.88-6.34)
$50,000-99,999	106 (3.9)	1.90 (1.37-2.64)	90 (25.6)	1.93 (1.35-2.77)	16 (0.7)	1.74 (0.78-3.94)
$100,000-149,999	89 (3.3)	1.65 (1.18-2.32)	80 (23.5)	1.78 (1.24-2.57)	9 (0.4)	1.00 (0.40-2.52)
≥$150,000	54 (2.0)	Ref	45 (13.2)	Ref	9 (0.4)	Ref
Refused/Doesn't know	12 (5.8)	2.88 (1.54-5.38)	9 (39.1)	2.95 (1.44-6.04)	3 (1.6)	+

Note. PR=Prevalence Ratio; CI = Confidence Interval, USD = United States dollar. +Estimate suppressed due to cell size <5 in exposure or referent group. [a]Frequencies and percentages obtained from a single imputed dataset. [b]Estimates from separate unadjusted (i.e., bivariate) modified Poisson models, estimated by imputed dataset and combined across imputations.

Preconception Behavioral Factors Associated with Cannabis Use in Pregnancy

Greater frequency of preconception cannabis use was strongly positively associated with cannabis use in pregnancy among the full sample and with persistent cannabis use (vs. discontinuation; Table 4). For example, more than half (54.6%) of participants who used cannabis daily during preconception reported continued cannabis use, compared with just 10.2% of participants who used cannabis <1 day/week (PR = 4.27, 95%CI = 3.07-5.93). Compared with those who never smoked cigarettes, participants who were current regular cigarette smokers in preconception were nearly three times as likely to report cannabis use in pregnancy among the full sample (PR = 2.76, 95%CI = 1.82-4.19). However, current regular smoking was not meaningfully associated with persistent cannabis use (vs. discontinuation) among participants who used cannabis in preconception (PR = 1.24, 95%CI = 0.79-1.94).

Similarly, greater alcohol use in preconception was positively associated with any cannabis use in pregnancy among the full sample (PR ≥7/week vs. none = 2.72, 95%CI = 1.91-3.88) and with new uptake of cannabis among participants who did not use cannabis in preconception (PR ≥7/week vs. none = 2.87, 95%CI = 1.18-6.95). However, among participants who used cannabis in preconception, PRs for greater intensity of alcohol indicated inverse (though imprecise) associations with persistent cannabis use (PR ≥7/week vs. none = 0.78, 95%CI = 0.53-1.16).

History of diagnosed depression and/or anxiety were consistently positively associated with cannabis use during early pregnancy among the full sample (PR range = 1.92-2.04), with persistent cannabis use among participants who reported cannabis use during preconception (PR range = 1.35-1.41), and with new uptake of cannabis among those who reported no cannabis in preconception (PR = 2.01-2.15). The highest (vs. lowest) quartile of current perceived stress was associated with any cannabis use (PR = 1.66, 95%CI = 1.21-2.26) and new uptake of cannabis (PR = 2.37, 95%CI = 1.03-5.44), but it was not meaningfully associated with persistent cannabis use (PR = 1.15, 95%CI = 0.82-1.62).

Preconception physical activity was not meaningfully associated with cannabis use (any vs. none, persistent use, or new uptake) in early pregnancy. Use of prenatal supplements was inversely associated with cannabis use in pregnancy among the full sample (PR = 0.67, 95%CI = 0.51-0.89), although the PR was weaker for persistent cannabis use (vs. discontinuation; PR = 0.86, 95%CI = 0.64-1.15) and was imprecise for new uptake (PR = 0.63, 95%CI = 0.29-1.33).

Table 4. *Preconception Behavioral Factors Associated with Cannabis Use in Early Pregnancy*

	Among Full Sample (n = 9,200)		Among Participants Who Used Cannabis in Preconception (n = 1,195)		Among Participants Who Did Not Use Cannabis in Preconception (n = 8,005)	
	Any vs. No Cannabis Use		Persistent Use vs. Discontinuation		New Uptake vs. Persistent Non-use	
Preconception Factor	N(%) outcome[a]	PR (95%CI)[b]	N(%) outcome[a]	N(%) outcome[a]	N(%) outcome[a]	PR (95%CI)[b]
Cannabis use						
Non-use	44 (0.6)	0.05 (0.04-0.08)	0 (0.0)	+	0 (0.0)	+
<1 day/week	72 (10.2)	Ref	72 (10.2)	Ref	0 (0.0)	+
1-3 days/week	64 (33.3)	3.02 (2.15-4.24)	64 (33.3)	3.07 (2.18-4.31)	0 (0.0)	+
4-6 days/week	46 (41.4)	3.43 (2.34-5.01)	46 (41.4)	3.49 (2.38-5.10)	0 (0.0)	+
Daily	102 (54.6)	4.05 (2.93-5.62)	102 (54.6)	4.27 (3.07-5.93)	0 (0.0)	+
Cigarette smoking						
Never	207 (2.6)	Ref	175 (20.4)	Ref	32 (0.5)	Ref
Former	77 (8.0)	2.39 (1.82-3.12)	68 (30.1)	1.33 (0.99-1.77)	9 (1.2)	1.93 (0.89-4.19)[c]
Current occasional	14 (7.7)	2.16 (1.25-3.73)	14 (26.9)	1.12 (0.65-1.93)	0 (0.0)	+
Current regular	30 (14.4)	2.76 (1.82-4.19)	27 (47.4)	1.24 (0.79-1.94)	3 (2.0)	+
Alcohol use						
none	70 (2.8)	Ref	58 (35.6)	Ref	12 (0.5)	Ref
1-6/week	197 (3.5)	1.72 (1.29-2.29)	174 (22.6)	0.86 (0.63-1.18)	23 (0.5)	1.24 (0.62-2.54)
≥7/week	61 (5.6)	2.72 (1.91-3.88)	52 (19.9)	0.78 (0.53-1.16)	9 (1.1)	2.87 (1.18-6.95)
Depression diagnosis						
No	188 (2.7)	Ref	162 (20.4)	Ref	26 (0.4)	Ref
Yes	140 (6.1)	1.92 (1.53-2.39)	122 (30.4)	1.35 (1.06-1.72)	18 (1.0)	2.01 (1.10-3.70)
Anxiety diagnosis						
No	173 (2.6)	Ref	149 (20.0)	Ref	24 (0.4)	Ref
Yes	155 (5.9)	2.04 (1.64-2.54)	135 (30.2)	1.41 (1.11-1.78)	20 (0.9)	2.15 (1.19-3.92)
Perceived stress scale-10						
Q1	62 (2.6)	Ref	54 (20.3)	Ref	8 (0.4)	Ref
Q2	51 (2.9)	1.03 (0.71-1.50)	46 (19.8)	0.93 (0.62-1.39)	5 (0.3)	0.82 (0.27-2.52)
Q3	87 (3.1)	1.03 (0.74-1.44)	76 (22.0)	0.97 (0.67-1.38)	11 (0.5)	1.08 (0.43-2.71)
Q4	128 (5.7)	1.66 (1.21-2.26)	108 (30.9)	1.15 (0.82-1.62)	20 (1.1)	2.37 (1.03-5.44)
Total MET/hr						
Q1	86 (3.7)	0.83 (0.60-1.13)	74 (26.1)	0.92 (0.65-1.30)	12 (0.6)	0.88 (0.38-2.08)
Q2	88 (3.8)	1.00 (0.73-1.35)	79 (26.6)	1.09 (0.78-1.52)	9 (0.4)	0.78 (0.32-1.93)
Q3	78 (3.5)	0.94 (0.68-1.29)	65 (22.1)	0.93 (0.66-1.31)	13 (0.7)	1.25 (0.55-2.85)
Q4	76 (3.3)	Ref	66 (20.7)	Ref	10 (0.5)	Ref
Prenatal supplements						
No	66 (6.2)	Ref	57 (32.2)	Ref	9 (1.0)	Ref
Yes	262 (3.2)	0.67 (0.51-0.89)	227 (22.3)	0.86 (0.64-1.15)	35 (0.5)	0.63 (0.29-1.33)

Note. PR=Prevalence Ratio; CI=Confidence Interval. +Estimate suppressed due to cell size <5 in exposure or referent group. [a]Frequencies and percentages obtained from a single imputed dataset. [b]Estimates from separate modified Poisson models adjusted for participant age, education, income, and marital status, and estimated by imputed dataset and combined across imputations.[c]Model excluded current occasional smokers to avoid convergence issues.

Nausea and Vomiting During Pregnancy and Cannabis use in Pregnancy

Participants who reported experiencing NVP were less likely to report any cannabis use among the full sample (PR = 0.49, 95%CI = 0.40-0.62), persistent cannabis use (vs. discontinuation) among those using cannabis in preconception (PR = 0.48, 95%CI = 0.38-0.62), and new uptake of cannabis (PR = 0.39, 95%CI = 0.22-0.71; Table 5). After restricting to participants who were at least 8 weeks pregnant at the time they reported NPV, associations were slightly attenuated and more

imprecise but still indicated inverse associations (Supplemental Table 2).

Table 5. *Association of Nausea and Vomiting During Pregnancy with Cannabis Use in Early Pregnancy*

	Among Full Sample (n = 9,200)		Among Participants Who Used Cannabis in Preconception (n = 1,195)		Among Participants Who Did Not Use Cannabis in Preconception (n = 8,005)	
	Any vs. No Cannabis Use		Persistent Use vs. Discontinuation		New Uptake vs. Persistent Non-use	
	N(%) outcome[a]	PR (95%CI)[b]	N(%) outcome[a]	PR (95%CI)[b]	N(%) outcome[a]	PR (95%CI)[b]
NVP in Early Pregnancy						
Yes	193 (2.9)	0.49 (0.40-0.62)	170 (19.4)	0.48 (0.38-0.62)	23 (0.40)	0.39 (0.22-0.71)
No	135 (5.4)	Ref	114 (36.1)	Ref	21 (0.96)	Ref

Note. NVP=Nausea and Vomiting During Pregnancy; PR=Prevalence Ratio; CI=Confidence Interval. [a]Frequencies and percentages obtained from a single imputed dataset. [b]Estimates from separate modified Poisson models adjusted for participant age, education, income, and marital status, and estimated by imputed dataset and combined across imputations.

DISCUSSION

In this prospective cohort study of North American pregnancy planners who conceived during 2013-2025, more than one-quarter of participants who used cannabis during preconception continued to use cannabis during early pregnancy, while <1% reported new uptake of cannabis in pregnancy. Greater frequency of cannabis use during preconception was the strongest risk factor for persistent cannabis use in early pregnancy. Lower SES, being unmarried, age less than 25 years, and history of diagnosed depression and/or anxiety were risk factors for persistent cannabis use and new uptake during pregnancy. Risk factors were mostly similar for persistent cannabis use, new uptake, and any cannabis use in pregnancy. However, while greater frequency of alcohol use and cigarette smoking were risk factors for any cannabis use in early pregnancy among the full sample, alcohol and cigarette use were not associated with persistent cannabis use among participants who used cannabis in preconception.

We observed differences in prevalence and behavioral transition probabilities across cannabis, alcohol, and cigarettes. The overall prevalence of use both before and during pregnancy was highest for alcohol and lowest for cigarette smoking. However, when examining behavioral transitions among participants who reported using the respective substances before pregnancy, prevalence of continued use was higher for cigarette smoking (46%) than for cannabis (24%) or alcohol (27%). Although tobacco and cannabis use share similar attributes (e.g., often smoked and inhaled), the findings suggest that the cessation rate during pregnancy for cannabis may be more similar to that of alcohol than cigarette smoking. Nicotine is a highly addictive stimulant, and the high rates of cigarette continuation in pregnancy highlight the difficulty that many pregnant individuals (nearly half in this study) have with smoking cessation (Forray et al., 2015). Although rates of continuation were lower for cannabis than cigarettes, nearly one-quarter of all participants who used cannabis in preconception continued to use cannabis in early pregnancy, with continuation probability increasing to more than 50% among those using cannabis daily during preconception. These findings highlight the importance of cannabis cessation interventions for pregnant individuals and those attempting to conceive who frequently use cannabis, as well as educational initiatives on the potential risks of cannabis use during pregnancy.

As in prior research (Corsi et al., 2019; El Marroun et al., 2008; Ko et al., 2015; Mark et al., 2016; Young-Wolff et al., 2019), there was a greater probability of cannabis use in pregnancy for younger participants, unmarried participants, and those with lower income and education. Such sociodemographic characteristics are also associated with use of other substances (e.g., tobacco, alcohol) in pregnancy (R. A. Brown et al., 2019; Havens et al., 2009; Riaz et al., 2018). Findings may reflect differences in cannabis harm

perceptions across subpopulations. Cannabis risk perceptions have decreased over time in the US (Waddell, 2022) including among pregnant individuals (Jarlenski et al., 2017), and cannabis harm perceptions are lower among younger individuals and those with lower SES (Odom et al., 2020). Sociodemographic differences may also reflect differences in external stressors during pregnancy. Prior studies suggest that unmarried and lower-SES participants experience more perceived stress during pregnancy than married and higher-SES individuals, potentially due to lower social or financial support (Latuskie et al., 2019; McLeod et al., 2022); greater stress was associated with cannabis use during pregnancy in this and prior studies (Allen et al., 2020; Constantino-Pettit et al., 2024). Sociodemographic correlates were similar for all cannabis use outcomes examined in this study (any use, persistent use, new uptake), suggesting consistent associations regardless of whether individuals are continuing cannabis use or exhibiting new uptake behaviors.

In this study, current cigarette smoking was associated with greater probability of cannabis use in pregnancy among the full sample, and greater alcohol use was associated with cannabis use in pregnancy among the full sample and with new uptake of cannabis. Cannabis use is highly intertwined with cigarette and alcohol use in the general population and among reproductive-age and pregnant women (Tran et al., 2023), and prior studies have similarly found associations of other substance use with cannabis use in pregnancy (Ko et al., 2015; Mark et al., 2016; Pike et al., 2021; Taylor et al., 2021). However, associations of cigarette smoking with cannabis use substantially attenuated when restricting to participants who used cannabis during preconception. Further, alcohol use appeared to be inversely associated with persistent cannabis use, though PRs were imprecise. These findings suggest that while cigarette smoking and alcohol use may be associated with cannabis use in general among those attempting to conceive, they were not specifically risk factors for cannabis continuation (or cessation) among participants who were already using cannabis during preconception. In contrast, a history of diagnosis of depression and anxiety were consistently associated with cannabis use in pregnancy, including both cannabis continuation and new uptake. Poor mental health has been associated with cannabis use in prior studies of pregnant individuals (Q. L. Brown et al., 2023; Constantino-Pettit et al., 2024; Mark et al., 2016; Young-Wolff et al., 2020), and those reporting use of cannabis in pregnancy to cope with mental health symptoms (Barbosa-Leiker et al., 2020; Constantino-Pettit et al., 2024; Gunn et al., 2024; Vanstone et al., 2021). These findings highlight a critical need for treatment of mental health symptoms among pregnant individuals and those contemplating pregnancy and targeted interventions for cannabis cessation for individuals with comorbid mental health issues.

We found that self-reported NVP was inversely associated with any cannabis use, persistent cannabis use, and new uptake of cannabis in early pregnancy. These results are inconsistent with prior studies that find positive associations of NVP with cannabis use in pregnancy (Metz et al., 2022; Vanderziel et al., 2023; Young-Wolff et al., 2018). It is possible that the use of cannabis during early pregnancy may have proactively lessened symptoms and prevented some individuals who used cannabis from experiencing nausea, as cannabis has been used historically as an antiemetic and has been shown to be effective for nausea relief in other patient populations (Whiting et al., 2015), with some evidence of self-reported effectiveness in pregnant populations (First et al., 2022; Swenson, 2023); however, frequent cannabis use can also induce hyperemesis (Angulo, 2024). Alternatively, among preconception cannabis users, nausea may have contributed to greater rates of discontinuation due to new aversions to the behavior, which has been reported in qualitative studies as a reason for discontinuing smoking cigarettes (Latuskie et al., 2019). Another possible explanation is that cannabis use during preconception or early pregnancy may be associated with increased miscarriage risk (Lo et al., 2024), which is inversely associated with NVP (Hinkle et al., 2016).

This study has limitations. All behaviors were self-reported and subject to misclassification. However, given the prospective design, misclassification of preconception behaviors is likely non-differential by cannabis use in pregnancy. We did not collect information on mode of cannabis use (i.e., smoking vs. vaping vs. edible use), or reasons for cannabis use in

pregnancy. That information could provide additional context on use behaviors and intentions in pregnancy. Measurement of cannabis use in pregnancy occurred early in pregnancy (average gestational age of 9.5 weeks) and assessed past-month use. Some participants may have used cannabis before knowing they were pregnant, and gestational weeks at the pregnancy questionnaire were slightly lower for those who used cannabis; however, the sample included participants actively attempting to conceive and participants detected their pregnancies on average at ~4-weeks, reducing concerns that a substantial proportion of participants who reported cannabis use during pregnancy would have done so before knowing they were pregnant, or that reports of cannabis use during pregnancy reflected only preconception behaviors. Additionally, preconception cannabis use was only assessed on the most recent preconception assessment; thus some participants classified as not using cannabis during preconception may have used cannabis earlier during the preconception timeline. Few participants reported new uptake of cannabis in pregnancy, resulting in wide CIs and suppression of some PRs due to small numbers within categories. Finally, while the study included a large cohort of individuals from across the US and Canada, the results may not extend to the general population of pregnancy planners or to individuals with unplanned pregnancies in North America. The prevalence of cannabis use in early pregnancy in our study population (3.6%) was lower than other estimates from nationally representative samples (Hayes et al., 2023; Volkow et al., 2019).

In this prospective cohort study of North American individuals planning a pregnancy who conceived during 2013-2025, nearly one quarter of individuals who used cannabis before becoming pregnant continued to use cannabis during the first trimester of pregnancy. Prevalence of cannabis continuation was substantially higher for individuals who used cannabis daily during preconception, and continuation of cannabis and new uptake of cannabis in pregnancy were more prevalent among participants with lower education, lower income, younger age, and history of mental health diagnoses, and those who were unmarried. Contrary to prior research, cannabis use in early pregnancy was less prevalent among participants who reported NVP. Findings highlight the need for targeted cannabis cessation resources for individuals attempting to conceive and those who become pregnant, particularly for individuals engaging in frequent cannabis use and with comorbid mental health issues.

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Funding and Acknowledgements: Research was supported by the National Institute on Drug Abuse under award number K01DA058084 (PI: Harlow) and the Eunice Kennedy Shriver National Institute of Child Health and Human Development under award number R01HD086742 (PI: Wise). The funders had no role in the design and conduct of the study; collection, management, analysis, or interpretation of the data; or preparation, review, or approval of the manuscript. The authors have no conflicts of interest relevant to this article to disclose.

Early View Date: May 21, 2026