HHS Public Access

Author manuscript

Drug Alcohol Depend. Author manuscript; available in PMC 2022 October 01.

Published in final edited form as:

Drug Alcohol Depend. 2021 October 01; 227: 108939. doi:10.1016/j.drugalcdep.2021.108939.

Correlates of Continued Cannabis Use During Pregnancy

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Abstract

Background: Cannabis use is increasingly common among pregnant women despite concern that it may be linked to adverse maternal and infant outcomes. Determining whether variables associated with cannabis use predict whether women continue or quit using during pregnancy may inform strategies to reduce prenatal use.

Methods: Pregnant women who regularly used cannabis before pregnancy (n=296) were recruited via Facebook. After finding out they were pregnant, 41% reported quitting, 13% quit then relapsed, 32% reduced use, and 15% continued use at the same rate. Differences among these four cannabis use status groups (quit, relapsed, reduced, continued) in sociodemographics, cannabis use, cigarette use, perceived risk/benefit, delay discounting, and communications about cannabis with their doctor were assessed.

Results: Compared to those who quit, continuing use during pregnancy was associated with being unemployed (Relative Risk (RR)=.32, 95%CI[.13,.78]), using cigarettes pre-pregnancy (RR=3.43, 95%CI[1.32,8.94]), being in an earlier trimester (RR=4.38, 95%CI[1.18,16.23]), less perceived risk (RR=.79, 95%CI[.74,.85]), and more days per week of use pre-pregnancy (RR=.10, 95%CI [.01,.84]). Unintended pregnancy, shorter time to cannabis use after waking pre-pregnancy, using cannabis more times per day pre-pregnancy, and greater perceived benefits of use had significant bivariate associations with continued use during pregnancy, but did not retain significance in a multinomial model.

Conclusions: Identification of these correlates provides potential targets for prevention of or intervention for prenatal cannabis use. However, much more research is needed to understand

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Contributors

CKP, MJS, and AJB conceptualized the study. CKP collected the data, and CKP and MJS performed data analysis. CKP and AJB prepared the manuscript. All authors finalized the manuscript.

Conflict of Interest

No conflict declared.

Declarations of interest: none.

prenatal cannabis use and its effects in order to better educate women and healthcare providers, and to design optimal public health strategies.

Keywords

pregnancy; cannabis; marijuana; risk perception; cessation

1. Introduction

In 2016, the estimated prevalence of past-month cannabis use among pregnant women was 7.0%, having more than doubled from 3.4% in 2002 (Volkow et al., 2019). During that same period, first trimester cannabis use also increased from 5.7% to 12.1%. One reason for the increase may be the concurrent rise in the number of states who have legalized cannabis for medical and recreational use (Jarlenski et al., 2017). Such widespread legalization may be leading women to see cannabis use during pregnancy as not only safe, but beneficial. In a recent survey, women who used cannabis during pregnancy espoused its benefits, reporting that it helped with their nausea and anxiety, and improved their ability to sleep (Kaarid et al., 2020).

However, cannabis use during pregnancy has also been linked to adverse pregnancy outcomes, raising concerns about the increase in use. Although these data do not establish causality, a growing literature has reported an association between prenatal cannabis use and preterm birth, low birthweight, and increased likelihood of neonatal intensive care (Corsi et al., 2019; Gunn et al., 2016; Hayatbakhsh et al., 2012). The findings on long-term consequences are inconsistent (El Marroun et al., 2018), with some studies suggesting that prenatal cannabis exposure is associated with behavioral issues and decreased attention span through adolescence (Fried & Watkinson, 2001; Goldschmidt et al., 2000), while others report a lack of evidence demonstrating a relationship between prenatal cannabis exposure and reduced cognitive functioning in childhood (Torres et al., 2020). Though firm conclusions regarding the adverse effects are premature, the American College of Obstetricians and Gynecologists discourages doctors from recommending cannabis for medicinal reasons during preconception, pregnancy, and breastfeeding (American College of Obstetricians and Gynecologists, 2017). Because prenatal cannabis use may have negative prenatal consequences, identifying and understanding factors that differentiate women who quit using cannabis during pregnancy from those who continue to use can inform the development of intervention strategies for reducing cannabis use and its potential adverse effects.

Little is known about factors that predict whether women will continue using cannabis during pregnancy. To our knowledge, only two studies have examined variables that may be linked to continuing or quitting. Allen et al. (2020) found that of the 997 women identified as having used cannabis prior to pregnancy in the national Pregnancy Risk Assessment Monitoring System (PRAMS) study, 36% reported continued use during pregnancy. Women who reported six or more stressful life events in the year prior to giving birth were more likely to continue use. Mark et al. (2017) surveyed a convenience sample of 106 women from an outpatient clinic in Maryland who reported using cannabis prior to pregnancy, and

found that 34% continued to use during pregnancy. Not graduating from high school, using tobacco cigarettes, and lower perceived risk of harm to the fetus or newborn were associated with continued use, but employment status was not. Of note, some medical providers may be encouraging and not discouraging prenatal use (Young-Wolff et al., 2020), which may have substantial influence on pregnant women's perceptions of benefit and risk. The Mark et al. study assessed risk with only a single question, and perceptions of benefit were not explored. A more comprehensive assessment of perceived risks and benefits and of the communications pregnant women have with their medical providers is needed to enhance our understanding of how these factors may affect decisions about the use of cannabis when pregnant.

While research on cannabis use during pregnancy has been limited, the substantial body of literature on cigarette smoking after learning of pregnancy may offer some insight on variables that determine cannabis use among pregnant women. Demographic variables, including a lower education level (Higgins et al., 2009; Míguez et al., 2017; White et al., 2014), and being unemployed or unmarried (Balázs et al., 2018; Foley et al., 2011; Panjari et al., 1997; White et al., 2014) have been linked to continuing cigarette use during pregnancy. Pregnancy and smoking characteristics, including not being primiparous (i.e., not pregnant for the first time) (Balázs et al., 2018; Míguez et al., 2017; Solomon et al., 2004), having an unplanned pregnancy (Schneider et al., 2010; Solomon et al., 2004), younger age of initiation of smoking (Coleman-Cowger et al., 2016; Wakschlag et al., 2002), and heavier smoking pre-pregnancy (Higgins et al., 2009; Míguez et al., 2017; White et al., 2014) have also been associated with continuing to smoke, as have higher levels of depression (Coleman-Cowger et al., 2016; Smedberg et al., 2015) and anxiety (Míguez et al., 2017). Lower perceived risk to the fetus also predicts continued smoking (Ockene et al., 2002; Smedberg et al., 2015). Last, delay discounting (DD), an index of impulsivity that measures the tendency to devalue delayed rewards that is positively related to cigarette smoking in general (Bickel et al., 2019; Kim-Spoon et al., 2019; VanderBroek et al., 2016), is also positively associated with continued smoking during pregnancy (White et al., 2014).

The current study used social media to recruit, enroll, and survey pregnant women who had used cannabis pre-pregnancy. Survey items assessed sociodemographics, pregnancy characteristics, cannabis use characteristics, cigarette use, perceptions of risk/benefit, DD, anxiety, depression, and communications with doctors. Analyses were performed to assess associations between these variables and cannabis use or quitting behavior post becoming pregnant.

2. Materials and methods

2.1. Participants

Participants were pregnant women (n=296) recruited online via Facebook's and Instagram's advertising platforms using procedures similar to prior cannabis survey studies (Borodovsky et al., 2018). The ads targeted individuals with interests related to pregnancy and/or cannabis use (e.g., keywords: NORML, pregnancy), and stated that "Dartmouth College researchers are doing a research study about opinions on pregnancy and marijuana use." Ads contained a hyperlink directing participants to a Qualtrics survey, where they viewed an informed

consent document approved by Dartmouth's Institutional Review Board. Participants then completed an initial eligibility survey. Inclusion criteria were: (1) 18 years or older, (2) reside in the U.S., (3) currently pregnant, and (4) used cannabis at least weekly during the *three months prior to pregnancy*. The survey took 8–12 minutes to complete, and participants had a 1 in 50 chance of winning a $25 Amazon gift card. To reduce concerns that some women may give false information to qualify for the study or complete the study more than once to have a chance to obtain a gift card, we employed effective strategies such as using the "Prevent Ballot Box Stuffing" feature in Qualtrics (Borodovsky et al., 2018). We also monitored timestamps from each survey, and surveys submitted consecutively within a small period of time were eliminated from the final analyses.

The hyperlink to the survey presented in the advertisement was clicked by 2,926 people; 856 completed the eligibility survey, and 468 were *not* eligible (one was younger than 18 years, 269 were not currently pregnant, and 198 did not report using cannabis weekly during the three months prior to pregnancy). Of the 388 women who *were* eligible, 71 did not fully complete the survey, 18 were judged to be duplicate responses, two finished the survey in less than 250 seconds (the cutoff for exerting reasonable effort into completion of the survey), and one had a poor reCAPTCHA score of 0.3 (indicating high likelihood it was completed by a bot). This resulted in n=296 for the primary analyses.

2.2. Measures

2.2.1 Attention checks—To ensure adequate attention to the survey and to prevent bots from completing the survey, two attention checks were included. No participant missed both attention checks. Eighty-five missed one check, however, these women, on average, spent equal or greater time on the survey compared to those who did not miss either attention check, so they were maintained in the final sample.

2.2.2 Demographics and pregnancy characteristics—Sociodemographic items asked about age, race, marital status, employment status, and education level. Pregnancy items asked participants how many weeks pregnant they were currently, whether this was their first pregnancy, and whether the pregnancy was intended.

2.2.3 Substance use—Participants were asked about their cannabis use, and those who reported using cannabis and cigarettes were asked about use of both substances. Cannabis items included: age of initiation of regular use, perceptions about ease of quitting, lifetime quit attempts, and use during the three months *prior to pregnancy* including methods of administration, number of days/week and times/day of use, and level of intoxication (high) typically attained (10-point scale; Borodovsky et al., 2020).

Cannabis status during pregnancy was assessed by asking if, *when you found out you were pregnant,* did you (1) quit using cannabis and not use it for the rest of your pregnancy, (2) quit using cannabis but relapse during pregnancy, (3) cut down (reduce) your cannabis use but never completely stop, or (4) continue using about the same amount of cannabis. Those who reported reducing or continuing cannabis use during pregnancy were asked about methods of administration, number of days/week and times/day of use, and level of intoxication *during pregnancy.* Those who reported quitting then relapsing were asked

how many consecutive weeks of abstinence were achieved before relapsing. Participants also completed the Cannabis Use Disorder Identification Test—Short-Form (CUDIT-SF) as a proxy measure of Cannabis Use Disorder, which has been validated among various populations from multiple countries (Bonn-Miller et al., 2016).

Tobacco items asked about number of days/week and number of cigarettes smoked/day *prior to pregnancy.* Tobacco status during pregnancy was assessed using the same four options for cannabis status (above). Smoking rates *during pregnancy* and perceptions about ease of quitting were assessed but are not included in this report.

2.2.4 Perceived risk and benefit of prenatal cannabis use—Risk perception was assessed with a 13-item measure (Table 3) that comprised statements related to short and long-term adverse outcomes *to the baby* from cannabis use during pregnancy (adapted from Haslam & Draper, 2000). The original measure included 12 items about the adverse outcomes to the baby from smoking cigarettes during pregnancy. We changed the term “smoking” to “using marijuana” in each of these items. Additionally, we added one item, “Can allow harmful chemicals to pass from mother to baby,” because prior studies have found that THC can remain in breastmilk for as long as 6 days after using cannabis (Bertrand et al., 2018), and that babies exposed to THC in breastmilk may have adverse developmental outcomes (Astley & Little, 1990; Liston, 1998). Participants rated their agreement with each of the 13 statements on a 5-point Likert scale ranging from “strongly disagree” to “strongly agree.” Items were summed (0–52 scale), with higher scores indicating greater perceived risk. Likert scale responses to each statement were converted into a “percent who agreed” variable (Table 3); those who answered “strongly agree” or “agree” were considered in agreement with that statement, and those who answered “strongly disagree,” “disagree,” or “don’t know” were considered not in agreement. A second measure, an eight-item questionnaire, was developed by our team to assess general perceptions of risk and benefit of cannabis use *to the baby* and *to the mother* (Table 4) using the same 5-point Likert scale. Similarly, responses were converted into a “percent who agreed” variable. We also developed a third measure looking at perception of benefit *to the mother*, which consisted of a list of 13 potential benefits of cannabis use during pregnancy, and required yes/no responses.

2.2.5 Delay discounting—Delay discounting (DD), an index of impulsivity that measures the tendency to devalue delayed rewards (Bickel et al., 2019; Kim-Spoon et al., 2019; VanderBroek et al., 2016), was assessed using the Five-Trial Delay Discounting Task, which has demonstrated reliability and validity in prior studies (Koffarnus & Bickel, 2015). A standard index of DD, k, was obtained reflecting how steeply the delay time degrades the value of the reward (Odum, 2011). For analyses, k values were transformed to $\ln k$ values to reduce positive skew, as in previous literature (Lee et al., 2015; Yi et al., 2017).

2.2.6 Depression and anxiety—Depression was assessed with the two-item Patient Health Questionnaire-2 (PHQ-2), which has been shown to be a reliable and valid measure for depression screening (Kroenke et al., 2003; Monahan et al., 2009). Anxiety was assessed with the two-item Generalized Anxiety Disorder-2 (GAD-2), which has also demonstrated reliability and validity in prior studies (Kroenke et al., 2007; Seo & Park, 2015).

2.2.7 Communications with doctor—Two items assessed whether participants discussed cannabis use with their doctor at a prenatal appointment, and if yes, who initiated the discussion. Two additional items asked if the doctor had discussed the potential benefits or harms of cannabis use during pregnancy, and whether or not the doctor recommended quitting. Note that the survey items used the term "doctor" rather than a more inclusive term such as "medical provider," which may limit the generality of the findings.

2.2.8 Statistical methods—Participants were assigned to one of four cannabis use status groups (quit, relapsed, reduced, continued) and group comparisons were made on sociodemographics, cannabis use characteristics, cigarette use, perceptions of risk/benefit, DD, PHQ-2 and GAD-2 scores, and communications about cannabis with their doctor. Logistic regression tests were used for the binary variables, chi-square tests of independence were used for non-binary categorical variables, and ANOVAs were used for continuous variables. In cases where the overall test was significant ($p<.05$), paired comparisons were made using simple contrasts for binary variables, pairwise chi-squares for non-binary categorical variables, and Fisher's least significant difference for continuous variables. All analyses were conducted using IBM SPSS Statistics, Version 25.0.

Multinomial logistic regression analysis examined the relationships of each predictor variable to cannabis use status. Age, race (white vs. other), college degree (yes vs. no), employment status (employed vs. unemployed), pre-pregnancy cigarette use (yes/no), pregnancy intentions (intended/unintended), trimester, age of initiation of regular cannabis use, pre-pregnancy cannabis use (including time to first use after waking, use days/week, and use times/day), perceptions of risk, and perceptions of benefit were included as covariates in a 13-predictor model, and each covariate's significance was determined. The model was then fit with only those predictors found significant in the 13-predictor model. Predictors that remained significant in this smaller model were kept, and then each of the nonsignificant predictors from the original 13-predictor model were added back into the smaller model one by one to determine their significance. The final model included all the variables found to be significant. Model fit, goodness-of-fit, and the individual contributions of each overall predictor variable in the model were calculated prior to the variable estimates that separately contrasted the quit group from the relapsed, reduced, and continued groups. All analyses were conducted using IBM SPSS Statistics, Version 25.0.

3. Results

3.1. Participant characteristics, substance use, risks and benefits

Sociodemographic characteristics are presented in Table 1. The majority of participants (n=296) were white (72%), employed (61%), unmarried (55%), and did not have a college degree (53%). The average age was 27.3 (SD=6.1) years. The majority (61%) used cannabis seven days/week prior to pregnancy, and the most common primary method of use pre-pregnancy was smoking (74%). A minority (29%) reported using cigarettes prior to pregnancy.

At the time of survey completion, participants were an average of 18.6 weeks pregnant (Mdn=18, range: 2–40), and the majority were in the first (37%) or second (40%) trimester

of pregnancy. Those in the first trimester were an average of 7.8 weeks pregnant (Mdn=7, range: 2–13). A majority of the 296 participants reported this was their first pregnancy (69%) and that the pregnancy was unintended (51%).

The majority (96%) reported at least one benefit of using cannabis during pregnancy (Table 2). Commonly endorsed benefits were: reduces nausea (90%), reduces stress (83%), improves ability to sleep (80%), and safer than opioid painkillers (64%). Overall, most did not acknowledge any risks of prenatal cannabis use (Table 3). Only a minority believed it could result in a low birth weight baby (22%), increase likelihood of premature birth (19%), or allow harmful chemicals to pass from mother to baby (29%).

3.2. During pregnancy cannabis use

Forty-one percent (n=121) quit using cannabis when they found out they were pregnant and had not relapsed, 13% (n=37) quit then relapsed, 32% (n=95) reduced use, and 15% (n=43) continued using at about the same frequency/amount. These four cannabis status groups (quit, relapsed, reduced, and continued) were compared in subsequent analyses.

3.3. Cannabis use status comparisons

3.3.1. Sociodemographics—Continued cannabis users were significantly less likely to be employed and less likely to report that the pregnancy was intended compared to those in the quit group (Table 1). Those in the reduced group were significantly younger than those in the quit group, and those in the continued and reduced groups were significantly less likely to be in the third trimester of their pregnancy compared to those who relapsed.

3.3.2. Cannabis use pre-pregnancy—Overall, those in the continued group tended to report more frequent pre-pregnancy use (Table 1). For example, on average they used more days/week and more times/day than the quit group (ps<.05). Of note, continued users were significantly more likely to use cannabis within 30 minutes of waking than those who quit (p<.05). Additionally, those who reduced use were significantly less likely to have started using cannabis at age 21 or older compared to those in the quit group.

3.3.3. Cannabis use during pregnancy—Of those who reduced or continued using cannabis during pregnancy (n=138), 38 reported changing their method of administering cannabis. The most common changes were more frequent use of edibles (n=19) and vaping (n=15). These changes may reflect the perception that these methods as less harmful than smoking. Among those who reduced or continued use, 49% reported that it would have been fairly easy or very easy to quit using cannabis, 33% said it would have been fairly hard or very hard, and 32% said they tried to quit once they became pregnant but failed. Participants in the relapsed group (n=37) reported a mean of 8.9 (SD=6.9) consecutive weeks of abstinence before relapsing.

3.3.4. Cigarette use—Those in the continued, reduced, and relapsed groups were significantly more likely than those who quit to have smoked cigarettes pre-pregnancy (44%, 31%, and 46%, vs. 18%; Table 1). However, among those who used cigarettes (n=87), days/week of cigarette use and number of cigarettes/day pre-pregnancy did not differ significantly

between the four cannabis status groups. Whether tobacco smokers quit (n=53), relapsed (n=10), reduced (n=19) or continued (n=5) their cigarette use during pregnancy also did not differ by cannabis status group (p=.44).

3.3.5. Perceptions of risk and benefit—Continued users perceived significantly less risk of prenatal cannabis use *to the baby* compared to those in the quit, reduced, and relapsed groups. Those in the reduced and relapsed groups also perceived significantly less risk *to the baby* than those who quit (Table 1). Table 3 shows the 13 statements related to risk and the percentage that acknowledged each by cannabis status group. Additionally, those who continued, reduced, or relapsed reported a significantly greater number of prenatal cannabis use benefits *to the mother* compared to those who quit (Table 1). Those who continued or reduced use were also significantly less likely to believe that prenatal cannabis use can do mental and physical harm *to the baby* compared to those who quit, and more likely to believe it can have mental benefits *for the baby* (Table 4).

3.3.6. Delay discounting—The four cannabis status groups did not differ significantly in their ln$k$ values (Table 1), indicating that they did not discount the future at significantly different rates (i.e., they did not differ in their level of impulsivity).

3.3.7. Psychiatric symptoms—The four cannabis status groups did not differ significantly in scores on the GAD-2 or PHQ-2 (Table 1)

3.3.8. Communications with doctor—Only 38% (n=112) of participants reported discussing cannabis use with their doctor at a prenatal appointment. Since women in their first trimester may not have yet initiated prenatal care, subsequent analyses included only those women who were in their second on third trimester at the time of survey completion (n=80). Among these 80 women, those who continued or reduced their cannabis use were significantly less likely to report that their doctor recommended quitting for pregnancy compared to those who quit (47% and 59%, vs. 90%, respectively: Table 5).

3.4. Multinomial logistic regression: prediction of cannabis use status

The multinomial logistic regression showed that adding the 13 predictors to a model resulted in employment status, pre-pregnancy cigarette use, trimester, and risk perception being significant predictors of cannabis use status. When fitting a model with these four predictors only, they all retained significance. Adding the nine nonsignificant predictors back into the model and testing the resulting nine five-predictor models resulted in two additional significant predictors, age of initiation of cannabis use and days per week of cannabis use pre-pregnancy. Adding these six covariates to a model containing only the intercept improved the fit significantly ($\chi^2(27, n=296) = 167.5$, Nagelkerke R^2=.5, p<.001). Both deviance (p=1.0) and Pearson (p=.3) goodness-of-fit statistics were nonsignificant, suggesting a good model fit. Significant individual predictor contributions indicated that continuing to use cannabis during pregnancy was associated with being unemployed (χ^2=8.3, p=.04), using cigarettes pre-pregnancy (χ^2=14.5, p<.01), being in an earlier trimester of pregnancy (χ^2=20.5, p<.01), less perceived risk (χ^2=78.0, p<.001), and using cannabis more days/week pre-pregnancy (χ^2=14.6, p=.02). Additionally, reducing cannabis

use during pregnancy was associated with initiating cannabis use at a younger age (χ^2=12.9, p=.04).

Table 6 provides the regression statistics for the group comparisons using the quit group as the referent (see Supplemental Table 2 for group comparisons with the continued group as the referent). Being employed was associated with a 68% decrease in the odds of being in the continued group (Relative Risk (RR) =.32, 95%CI [.13, .78], p=.01) compared to the quit group. Using cigarettes pre-pregnancy was associated with a 3.43-fold increase in odds of being in the continued group (RR=3.43, 95%CI [1.32, 8.94], p=.01), and a 4.75-fold increase in the odds of being in the relapsed group (RR=4.75, 95%CI [1.96, 11.51], p<.001) compared to the quit group. Compared to the quit group, being in the first trimester of pregnancy was associated with a 4.38-fold increase in the odds of being in the continued group compared to those in the third trimester (RR=4.38, 95%CI [1.18, 16.23], p=.03), and a 78% decrease in the odds of being in the relapsed group (RR=.22, 95%CI [.07, .68], p<.01). The continued group perceived significantly less risk of cannabis use than the quit group (RR=.79, 95%CI [.74, .85], p<.001), indicating that a one-unit increase (52-unit range) in acknowledgement of risk corresponded with a 21% decrease in odds of being in the continued group. Compared to the quit group, starting to use cannabis between the ages of 18 and 20 corresponded to a 2.44-fold increase in the odds of being in the reduced group compared to those who started to use at 21 or older (RR=2.44, 95%CI [1.00, 5.94], p<.05). Last, compared to the quit group, those who reported using cannabis one or two days/week pre-pregnancy showed a 90% decrease in odds of being in the continued group compared to those who used seven days/week (RR=.10, 95%CI [.01, .84], p=.03) (Table 6).

4. Discussion

The findings from this study of pregnant women who used cannabis pre-pregnancy suggest that factors similar to those that predict tobacco cigarette use during pregnancy also predict cannabis use. These include employment status, use of tobacco cigarettes pre-pregnancy, trimester, perceived risk of prenatal cannabis use, frequency of pre-pregnancy cannabis use, and age of initiation of use. Other factors, including pregnancy intentions, time to first cannabis use after waking pre-pregnancy, cannabis use times/day pre-pregnancy, and perceived benefit of use were also predictive of use status during pregnancy, though they did not retain statistical significance in the regression analysis.

These observations suggest that certain sociodemographic factors may put women at greater risk for continued cannabis use during pregnancy. Our results also highlight correlates of continued use that may be changeable and thus may serve as targets for prevention and intervention strategies among those most at risk. Notably, most women in this sample reported little perceived risk in using cannabis during pregnancy. The majority did not acknowledge that it could lead to issues such as low birthweight, premature birth, and developmental problems during childhood, and those reporting such beliefs were less likely to quit cannabis use. Although the scientific data assessing these types of risks to the baby have been inconclusive, until more data become available, it may be prudent and most safe for women to avoid use during pregnancy (American College of Obstetricians and Gynecologists, 2017). The findings on perceived risk to the baby and benefit to the mother

suggest that interventions that effectively provide education about the potential for serious consequences might motivate reduction or quit attempts.

Tobacco cigarette use pre-pregnancy was another important marker for continued cannabis use, with 44% of those in the continued group also smoking cigarettes. Co-use of tobacco reduces cannabis reduction success rates and is a risk factor for continued use among the general population of cannabis users (Peters et al., 2012). In cases of such co-use among pregnant women, offering simultaneous or sequential interventions for both cigarette and cannabis use may be an effective course of action (Lee et al., 2019). Contingency management in particular has been shown to be successful for tobacco and for cannabis cessation (Budney et al., 2019; Davis et al., 2016), hence offering contingency-management based interventions that target both substances in addition to behavioral counseling or nicotine use disorder medications might be considered for those who do not quit on their own.

Many women in our study who reduced or continued use during pregnancy reported that it was not because they believed quitting would have been too challenging; indeed, about half of these women said quitting would have been very easy or fairly easy. This suggests that a nonjudgmental educational approach that discusses potential risks to their baby or an incentive-based approach such as contingency management may motivate them to quit. For the third of women in the reduced and continued groups who said they tried to quit but failed, more substantive multicomponent interventions, such as motivational enhancement therapy, contingency management, or cognitive behavioral therapy (Budney et al., 2019) should be considered in addition to education. Women who reported more frequent cannabis use pre-pregnancy may also benefit from these more potent interventions.

Of some concern, fewer than 4 in 10 women in this sample reported that they had discussed cannabis use with a doctor at a prenatal appointment. Further, among those who talked to their doctor, those in the quit group were nearly twice as likely to report that their doctor had told them to quit cannabis than those in the continued group. While interpretation of these data is limited by the use of the term “doctor,” rather than the more general term, “medical provider,” these observations suggest that it may be useful for all pregnancy healthcare providers to discuss the possible risks of cannabis use and to clearly review options for helping their patients quit. Because the data on the risks are not clear, it may be difficult for providers to know what to say (Holland et al., 2016). Development and dissemination of empirically-based educational materials and guidelines that can readily be communicated to patients is sorely needed. The ACOG and SAMHSA have educational materials available for women and healthcare providers (ACOG, 2017; SAMHSA, 2019), but these have yet to be tested. Healthcare providers are also in need of guidelines and training to support discussions with their patients about the commonly perceived potential benefits of prenatal cannabis use. In our study, almost all women reported that prenatal use has at least one benefit. Providers may benefit from being prepared to discuss and offer alternatives for the common conditions that pregnant women report benefits of cannabis, such as nausea, stress, and back pain.

A number of other limitations of this study warrant mention and illustrate the need for additional and larger studies. First, the sample was relatively small; notably, there were just 43 women in the continued group. The sample was also non-random and self-selected, so the women who chose to participate may have had strong or biased opinions about prenatal cannabis use that do not reflect the opinions of the general population of pregnant women who use cannabis. Because our social media recruitment targeted women who had demonstrated interests in cannabis-related organizations like NORML, it is possible that this sample had a skewed positive view of use or used cannabis in disproportionately high amounts. Hence, our findings may not be representative of the population of pregnant women who used cannabis pre-pregnancy. That said, our findings were generally congruent with the few prior studies, one of which enrolled women receiving prenatal care at a Maryland clinic (Mark et al., 2017), and the other which used the national PRAMS data (Allen et al., 2020). Second, data were collected retrospectively; ideally, the women would have taken the survey before *and* after becoming pregnant because their perceptions may have changed during that time. For example, those who continued to use cannabis while pregnant may have reported that they do not believe use could result in a low birthweight. However, they may have had different beliefs before becoming pregnant, but changed their reports to rationalize continuing their use during pregnancy. A third limitation was that the women self-reported their cannabis use, so abstinence from or reduction of use was not verified. It is possible that participants answered in socially desirable ways (i.e., reported they fully quit when they actually did not). Lastly, there was a large amount of variability in the number of weeks the women had been pregnant at the time of taking the survey. Over a third of the women were in their first trimester, and therefore their cannabis use status may have changed during the remainder of their pregnancy. For example, some women who reported quitting may have eventually relapsed as their pregnancy progressed, or some who did not report reduction or quitting may have gone on to quit later in pregnancy. Additionally, women very early in their first trimester may have been confused as to how best to answer the questions about their pregnancy, given that they had only recently learned that they were pregnant. Last, most women do not initiate prenatal care until several weeks into pregnancy, so when asked if they had talked to their doctor about cannabis use, those who were early in their pregnancies may not yet have done so.

Given the largely exploratory nature of this study, conclusions should be seen as tentative. Despite the aforementioned limitations, our results are similar to those found in studies of tobacco use among pregnant women. Our findings illustrate the common correlates of continued substance use during pregnancy, and highlight the issues facing pregnant women and healthcare providers when dealing with prenatal cannabis use. It should be noted, however, that the variables related to cannabis use during pregnancy do not completely overlap with the variables associated with tobacco use during pregnancy. Thus, future research is needed that more carefully accounts for differences between cannabis and tobacco users when exploring possible predictors of continued use patterns or quitting.

5. Conclusions

Employment status, use of tobacco cigarettes pre-pregnancy, trimester, perceived risk of prenatal cannabis use, frequency of pre-pregnancy cannabis use, and age of initiation of use

are robust predictors of cannabis use status during pregnancy. Identifying these and other important correlates may provide targets for intervention strategies, but further research is needed to fully understand prenatal cannabis use and its effects on the baby. Doing so will allow for improved education of women and healthcare providers and facilitate more proactive and effective strategies to address cannabis use among this vulnerable population.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Role of Funding Sources

This research was supported by the Paul K. Richter and Evalyn E. Cook Richter Memorial Fund, and by NIDA P30-DA029926 and T32-DA037202, which had no role other than financial support.

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Highlights

- Certain factors predicted whether women continued or quit cannabis for pregnancy
- Less perceived risk and more frequent use pre-pregnancy predicted continued use
- The odds of continued cannabis use were increased with pre-pregnancy cigarette use
- Being unemployed and in the first trimester of pregnancy predicted continued use
- Content of discussions about cannabis with a doctor were associated with use status

Table 1.

Participant characteristics (n = 296)

	Overall (n = 296)	Quit (n = 121)	Relapsed (n = 37)	Reduced (n = 95)	Continued (n = 43)	p-value
Demographics						
Maternal age (years) (M ± SD)	27.3 ± 6.1	28.4 ± 6.0[a]	27.7 ± 6.2[a, b]	26.1 ± 5.9[b]	26.3 ± 6.4[a, b]	**.025**
Race (% white)	72	71	68	67	91	.052
College degree or higher (%)	47	57[a]	43[a]	38[a]	44[a]	**.041**
Married (%)	45	52	32	44	35	.090
Employed (%)	61	72[a]	68[a, b]	57[b]	37[c]	**<.001**
Used cigarettes pre-pregnancy (%)	29	18[a]	46[b]	31[b]	44[b]	**.001**
Pregnancy characteristics						
Primigravida (first pregnancy) (%)	69	75	73	67	56	.122
Intended pregnancy (%)	49	57[a]	49[a,b]	49[a]	28[b]	**.017**
Trimester of pregnancy (%)						**.017**
1st	37	42[a]	19[a]	35[a]	42[a]	
2nd	40	35[a]	38[a]	46[a]	44[a]	
3rd	23	23[a, b]	43[b]	19[a]	14[a]	
Cannabis use characteristics						
Age started using (%)						**.023**
<18	45	41[a]	41[a]	46[a]	58[a]	
18–20	28	24[a]	22[a]	36[a]	26[a]	
>20	27	35[a]	38[a, b]	18[b]	16[a, b]	
Time to first use after waking, pre-pregnancy (%)						**.039**
<30 minutes	19	15[a]	19[a, b]		35[b]	
Use days/week, prepregnancy (%)						**<.001**
1–2 days	15	26[a]	11[a, b]	9[b]	2[b]	
3–6 days	24	31[a]	27[a]	19[a]	12[a]	
7 days	61	44[a]	62[a, b]	72[b]	86[b]	
Use times/day, pre-pregnancy (%)						**<.001**
1	19	31[a]	16[a, b]	9[b]	9[b]	
2–3	43	45[a]	43[a]	44[a]	33[a]	
4–5	27	17[a]	a' b	37[b]	35[a, b]	
6+	11	8[a]	14[a]	9[a]	23[a]	
Typical high, pre-pregnancy (1–10 scale) (M ± SD)	4.8 ± 1.6	4.7 ± 1.4	4.7 ± 1.8	4.9 ± 1.5	4.8 ± 1.8	.753

	Overall (*n* = 296)	Quit (*n* = 121)	Relapsed (*n* = 37)	Reduced (*n* = 95)	Continued (*n* = 43)	*p*-value
CUDIT-SF score (0–12) (M ± SD)	2.0 ± 2.8	1.9 ± 2.8	2.2 ± 2.8	2.0 ± 2.5	2.6 ± 3.3	.509
Perceived cannabis risks/benefits						
Prenatal use risk acknowledgement (0–52 scale) (M ± SD)	24.4 ± 8.1	29.1 ± 6.5[a]	24.5 ± 8.5[b]	21.1 ± 6.6[c]	18.4 ± 7.6[d]	<.001
# of prenatal use benefits endorsed (0–13) (M ± SD)	7.5 ± 3.0	6.3 ± 3.3[a]	8.0 ± 2.7[b]	8.1 ± 2.4[b]	9.0 ± 2.5[b]	<.001
Delay discounting (ln*k*) M ± SD)	−5.3 ± 2.1	−5.7 ± 1.8	−5.1 ± 2.3	−5.2 ± 2.4	−4.9 ± 2.1	.082
Psychiatric symptoms						
GAD-2 score (0–6) (M ± SD)	2.5 ± 1.9	2.3 ± 1.9	3.2 ± 2.0	2.4 ± 1.8	2.4 ± 1.9	.087
PHQ-2 score (0–6) (M ± SD)	1.9 ± 1.7	1.7 ± 1.7	2.5 ± 1.7	1.9 ± 1.7	1.7 ± 1.7	.147

Note. For binary variables, the *p*-value is based on logistic regression, for non-binary categorical variables, the *p*-value is based on chi-square tests of independence, and for continuous variables, the *p*-value is based on one-way analysis of variance. Percentages or means that share a letter (a, b, c, or d) are not significantly different from each other (α = .05)

[a]M = Mean

[b]SD = Standard Deviation

[c]GAD-2 = Generalized Anxiety Disorder-2

[d]PHQ-2 = Patient Health Questionnaire-2

Table 2.

Percent of participants who endorsed prenatal cannabis use benefits (n = 296)

Benefits	% That Endorsed
Reduces nausea	90
Reduces stress	83
Improves ability to sleep	80
Relaxes me	74
Reduces vomiting	72
Reduces back pain	68
Helps with headaches	64
Safer than opioid painkillers	64
More natural than opioid painkillers	63
Reduces depression	59
Reduces risk of preeclampsia	14
Reduces risk of gestational diabetes	7
Endorsed no benefits	4

Table 3.

Beliefs about prenatal cannabis use (n = 296)

Beliefs about prenatal cannabis use	*% who agreed with each belief*					
	Overall (n = 296)	**Quit (n = 121)**	**Relapsed (n = 37)**	**Reduced (n = 95)**	**Continued (n = 43)**	***P*-value**
Results in low birth weight baby	22	31[a]	22[a, b]	16[b]	9[b]	**<.01**
Smaller babies are easier to deliver	24	21	24	24	30	.650
Low birth weight leads to health problems in baby	62	72[a]	70[a, b]	52[b]	49[b]	**<.01**
More likely to give birth prematurely	19	26[a]	14[a, b]	17[a, b]	7[b]	**.034**
Child usually has more respiratory infections	8	13	5	6	2	.118
Affects child's growth and development up to age 10	13	25[a]	11[a, b]	3[b]	2[b]	**<.001**
Has an effect on child's IQ level	10	14	16	6	5	.121
Can allow harmful chemicals to pass from mother to baby	29	45[a]	35[a]	15[b]	14[b]	**<.001**
Pregnant women should be encouraged to stop using cannabis	34	59[a]	32[b]	12[c]	14[b, c]	**<.001**
There is not enough help for pregnant women who want to stop using cannabis	35	42[a]	43[a]	32[a, b]	19[b]	**.031**
Cutting down amount of cannabis used per day reduces harm to the baby	44	45	54	47	28	.100
Cannabis use of other adults in the home has an effect on the baby's health	20	27[a]	19[a, b]	15[b]	9[b]	**.038**
It is safe to use cannabis once the baby is born	70	56[a]	78[b]	76[b]	86[b]	**<.001**

Note. Percentages that share a letter (a, b, or c) are not significantly different from each other (α = .05). The p-value is based on logistic regression.

Table 4.

General perceptions of risk and benefit (n = 296)

	% who agree with each belief					
Beliefs about cannabis use	**Overall (n = 296)**	**Quit (n = 121)**	**Relapsed (n = 37)**	**Reduced (n = 95)**	**Continued (n = 43)**	***P*-value**
Cannabis has mental benefits for user	88	82[a]	86[a, b]	95[b]	91[a, b]	**.047**
Cannabis has physical benefits for user	83	77	89	86	86	.167
Cannabis can cause mental harm to user	25	36[a]	27[a, b]	17[b]	12[b]	**<.01**
Cannabis can cause physical harm to user	18	22	27	12	14	.094
Prenatal cannabis use can have mental benefits for the unborn child	13	6[a]	14[a, b]	16[b]	26[b]	**.011**
Prenatal cannabis use can have physical benefits for the unborn child	9	4	8	14	14	.087
Prenatal cannabis use can do mental harm to the unborn child	20	36[a]	19[a, b]	8[b]	2[b]	**<.001**
Prenatal cannabis use can do physical harm to the unborn child	20	36[a]	19[a, b]	7[b]	2[b]	**<.001**

Note. Percentages that share a letter (a or b) are not significantly different from each other (α = .05). The p-value is based on logistic regression.

Table 5.

Communications with doctor about prenatal cannabis use (n = 80)

	Quit (n = 21)	Relapsed (n = 13)	Reduced (n = 29)	Continued (n = 17)	p-value
Doctor said to quit for pregnancy (%)	90[a]	85[a, b]	59[b, c]	47[c]	**.022**
Doctor discussed benefits of prenatal use (%)	19	23	38	47	.249
Doctor discussed risks of prenatal use (%)	67	77	76	71	.879

Note. Table includes only those participants who discussed prenatal cannabis use with their doctor and were in their second or third trimester of pregnancy (n = 80). Percentages that share a letter (a, b, or c) are not significantly different from each other (α = .05). The p-value is based on logistic regression.

Table 6.

Parameter estimates (n = 296)

		B	SE	Wald	Sig.	RR	CI - RR	
							LB	UB
Continued vs. Quit	Intercept	3.78	1.06	12.79	***.00***			
	Employed	−1.14	.45	6.28	***.01***	.32	.13	.78
	Used Cigs Pre-Preg.	1.23	.49	6.39	***.01***	3.43	1.32	8.94
	First Trimester	1.48	.67	4.88	***.03***	4.38	1.18	16.23
	Second Trimester	1.00	.65	2.42	.12	2.73	.77	9.67
	Age Started Using Cannabis, <18	.84	.60	2.01	.16	2.33	.72	7.47
	Age Started Using Cannabis, 18–20	.56	.65	.75	.39	1.75	.49	6.23
	Used Cannabis 1–2 Days/Wk, Pre-Preg	−2.34	1.10	4.49	***.03***	.10	.01	.84
	Used Cannabis 3–6 Days/Wk, Pre-Preg	−.1.31	.59	4.87	***.03***	.27	.08	.86
	Risk Acknowledgement	−.24	.04	42.43	***.00***	.79	.74	.85
Reduced vs.Quit	Intercept	3.71	.84	19.52	.00			
	Employed	−.54	.35	2.38	.12	.58	.29	1.16
	Used Cigs Pre-Preg.	.69	.39	3.17	.07	2.00	.93	4.28
	First Trimester	.61	.47	1.69	.19	1.84	.73	4.60
	Second Trimester	.54	.45	1.41	.23	1.71	.71	4.13
	Age Started Using cannabis, <18	.72	.43	2.80	.09	2.04	.88	4.73
	Age Started Using Cannabis, 18–20	.89	.45	3.87	***.05***	2.44	1.00	5.94
	Used Cannabis 1–2 Days/Wk, Pre-Preg	−.93	.50	3.45	.06	.40	.15	1.05
	Used Cannabis 3–6 Days/Wk, Pre-Preg	−.80	.39	4.15	***.04***	.45	.21	.97
	Risk Acknowledgement	−.18	.03	41.44	***.00***	.84	.79	.88
Relapsed vs. Quit	Intercept	2.20	.96	5.22	.02			
	Employed	.16	.46	.12	.73	1.17	.48	2.86
	Used Cigs Pre-Preg.	1.56	.45	11.91	***.00***	4.75	1.96	11.51
	First Trimester	−1.50	.57	6.87	***.01***	.22	.07	.68
	Second Trimester	−.77	.49	2.43	.12	.46	.18	1.22
	Age Started Using Cannabis, <18	−.77	.50	2.30	.13	.47	.17	1.25
	Age Started Using Cannabis, 18–20	−.87	.57	2.30	.13	.42	.14	1.29
	Used Cannabis 1–2 Days/Wk, Pre-Preg	−1.37	.65	4.40	***.04***	.25	.07	.91
	Used Cannabis 3–6 Days/Wk, Pre-Preg	−.50	.47	1.14	.29	.61	.24	1.52
	Risk Acknowledgement	−.09	.03	8.46	***.00***	.92	.86	.97

Note. Multinomial logistic regression results comparing the quit vs. continued, reduced, and relapsed groups for each variable. The quit group is the reference category. Significance values for the overall model and specific comparisons are bolded and italicized. Third trimester is the referent category for trimester of pregnancy, >20 is the referent category for age started using cannabis, and seven days per week is the referent category for days per week of cannabis use prior to pregnancy.

[a] B = Estimated multinomial logistic regression coefficients for the model

[b] SE = Standard Error

[c] Wald = Wald Chi-Square Test

[d] Sig. = The *p*-values of the coefficients

[e] RR = Relative Risk

[f] CI = 95% Confidence Interval for RR

[g] LB = Lower Bound

[h] UB = Upper Bound