

Cannabis Usage and Patient Perception: Assessing Risks Versus Benefits during Pregnancy and the Six-Month Postpartum Period

Abstract

Research Question

What are the perceptions of the risks and benefits of Cannabis use during pregnancy of patients who are pregnant or in the six-month postpartum period with a social history of cannabis usage? Furthermore, do these perceptions differ from patients' perspectives of cannabis usage in general? How do these patients believe pregnancy is impacted by cannabis usage?

Background, Significance, and Rationale:

Marijuana, Δ^9 -tetrahydrocannabinol (THC), is one of the most commonly used illicit drugs in the United States. Since 1996, 33 states have passed Medical Marijuana Laws including 11 states that have passed recreational marijuana laws. While the increased usage of medical marijuana and recreational marijuana is correlated with increased acceptance and accessibility, the American College of Obstetricians and Gynecologists state that women should not use cannabis during preconception, pregnancy, and lactation. This recommendation is due to the main psychoactive component of cannabis crossing the placenta during gestation. In the midst of this recognition, the prevalence of current cannabis use during and after pregnancy has increased. This increase can be seen across a spectrum of factors including socioeconomic status, age, race, etc. However, less has been published regarding patient perceptions on risks and benefits of cannabis use during pregnancy and the clinical understanding of cannabis' effects during pregnancy and lactation. This study aims to elucidate what these perceptions may entail by surveying the previously or presently pregnant and six-month postpartum patients.

Materials and Methods: A cross sectional cohort study of previously or current pregnant and six-month postpartum patients were recruited for a survey. After creating a cross-sectional and comprehensive examination survey on usage of cannabis, the survey was distributed to John Peter Smith (JPS) Women's Health clinic. Before the administration of the survey, an introductory document explained the details of how the survey should be conducted in a professional manner. The patients at the medical clinic were offered to participate in the study's survey and given an appropriate consent and liability form. We used a qualitative description methodology to capture patients' perspectives on the risks and benefits of cannabis usage in the prenatal and six-month postpartum period.

Results: We anticipated that prenatal and six-month postpartum patients with a social history of cannabis usage would demonstrate survey responses consistent with the ideology that benefits of cannabis usage outweighs the risks. We expected this response due to the lack of evidence-based medicine on detrimental effects imposed on the fetus with cannabis usage during pregnancy. Furthermore, we demonstrated participants reporting cannabis use were more likely to be young, single, Hispanic or Black/African American females with an income less

than \$50,000. 30% participants report smoking marijuana 2-3 times per month (n=12). Participants were also asked if they believed there was harm in marijuana use during pregnancy or while breastfeeding and 55% (n=22) reported no or they did not know (m=1.98, std deviation 1.055). 55% (n=22) of the participants did not believe their health care providers did a good job in addressing marijuana usage during pregnancy or while breastfeeding.

Conclusions: After completion of the study, the findings would aid in producing harm reduction interventions by the healthcare physicians and advanced practice providers (APP) to decrease cannabis use. This will be vital to help prenatal and six-month postpartum women who are using cannabis for health management to continuously evaluate their use. This study entertains the idea that understanding the perceptions of cannabis usage during pregnancy and six months postpartum will aid in professional healthcare communication between the physician and patient to best address the cannabis usage and its effects.

Research Question

What are the perceptions of the risks and benefits of Cannabis use during pregnancy of patients who are pregnant or in the six-month postpartum period with a social history of cannabis usage? Furthermore, do these perceptions differ from these patients' perspectives of cannabis usage in general? How do these patients believe pregnancy is impacted from cannabis usage?

Hypothesis: There are two critical challenges that face the study of cannabis usage: cannabis usage is considered illegal in the state of Texas and a limited study population in Tarrant County. The specific objective of this research is to showcase the perceptions of cannabis usage during pregnancy and six-month postpartum to understand how these patients view cannabis usage amongst their population. We hypothesize that prenatal and six-month postpartum patients with a social history of cannabis usage will demonstrate survey responses consistent with the ideology that benefits of cannabis usage outweighs the risks.

Validation of this hypothesis were completed by patient-based surveys administered in 2021 that overcomes critical barriers to cannabis usage during pregnancy and six-months postpartum by (1) training medical providers to show no biases when conducting the survey and (2) induce a harm reduction intervention for patients.

Introduction, Significance and Rationale

Introduction

Epidemiological Overviewⁱ

Cannabis sativa, Δ^9 - tetrahydrocannabinol (THC), is one of the most commonly used illicit drugs in the United States and is often colloquially referred to as marijuana.[1] Cannabis is also the most commonly used illicit drug in pregnancy.[2] The continued legalization of cannabis in the United States has steadily increased to thirty-three states, while eleven of those have passed recreational marijuana laws.[3] Due to this steady increase in acceptance of cannabis, maternal cannabis usage has increased during pregnancy shown in a nationally representative study among the reproductive-age women of 18-44 years old.[2]

A study in 2020 concentrated on the prevalence of cannabis use for one month during pregnancy. Frequency of cannabis use increased from 2.37% in 2002 to 3.85% in 2014.[4] Furthermore, there was an increase in reported daily usage among pregnant patients in the past month. Maternal cannabis during pregnancy has nearly tripled in daily/nearly daily use in pregnant women, increasing from 0.9% to 3.4%.[4] In a study, 14 out of 100 women reported heavy use of cannabis during the first trimester of pregnancy, which was defined by smoking 1 or more joints per day, compared with 5.3% and 5.0% during the second and third trimesters of pregnancy.[5] Maternal cannabis users may also use marijuana during the six-month postpartum period. A survey in 2015 reported up to 15% cannabis usage in breastfeeding mothers.[4] There is little information regarding the impact of cannabis exposure to infants receiving breast milk.

There was reported data that there are higher rates of cannabis use among young women, disadvantaged communities, and minority populations that signifies the potential for adverse infant health consequences due to maternal marijuana use.[6] These findings can be further focused onto specific populations that report increased cannabis usage during pregnancy. These populations are proposed to potentially be at greater risk in reporting increased use due to many confounding variables. Such variables include age: pregnant patients in the age range of 18-25 years old have a reported percentage of maternal cannabis use of 7.47% in comparison to pregnant patients in the age range of 26-44 years old with 2.12% of reported usage.[4] Along with increased usage in younger patients, cannabis usage during pregnancy was associated with cannabis use by the biologic father, single mothers, lower education, and childhood trauma.[7] These variables are under the umbrella of socioeconomic status, which was reported to be the strongest determining factor for cannabis use during pregnancy.

Women using cannabis in pregnancy are more likely to use alcohol, tobacco, and illicit drugs, due to their additive or synergistic effects.[5] Ongoing research associates tobacco use to an increased likelihood of becoming cannabis dependent and vice-versa where cannabis use can

easily transition to tobacco use. Further, tobacco use threatens cannabis cessation attempts leading to increased and accelerated relapse rates among cigarette smokers.[8]

In patient perspective, cannabis use can be supported by multiple psychosocial factors such as stress relief, peer use, pain relief, and prior usage. A patient's beliefs and psychosocial factors can motivate usage of cannabis such as that cannabis can reduce nausea or depression.[9] Furthermore, people who are disadvantaged due to low income, low education, minorities, or facing adversities can exacerbate cannabis use and are more likely to harbor misperceptions regarding cannabis use during pregnancy due to unequal access to healthcare.[10]

There are various cannabis use methods and products that have steadily increased over the years. These cannabis use practices and products can contribute to increased risk from cannabis use during pregnancy and postpartum due to increased exposure and availability. The adverse effects associated with inhalation of cannabis can affect various organ systems such as the respiratory health or cardiovascular health.[11]

Compared to other research topics, there are less if no randomized controlled trials on cannabis use in pregnancy. The studies that are published do not exclude or control for polysubstance use, mixing the data and population. Furthermore, self-reported measures of cannabis use inherently comes with reporting bias that can underestimate the prevalence and use of cannabis in pregnancy and six-month postpartum period. Another factor to consider is the rising levels of THC potency in cannabis products that can act as a confounder.[12] Other socio-demographics confounders include pregnant women who use cannabis are more likely to have less education, lower household income, underweight or eating disorders, and are less likely to be compliant with medication during pregnancy, compared with nonusers.[12, 13]

Neurobiology of Cannabis Addiction

δ -9-tetrahydrocannabinol (THC) is the main psychoactive component of cannabis and acts as a partial agonist at cannabinoid Type-1 receptors (CB1Rs).[8] The effects of CB1R is important due to its role in modulating neurotransmitter release. The fashion in which it releases neurotransmitters is what maintains homeostasis by preventing excessive neuronal activity in the central nervous system. However, if altered can cause increased firing of neurotransmitters and the cause of the effects of cannabis.

The effects of these psychoactive cannabinoids release the neurotransmitters that increase the activity of mesolimbic dopaminergic neurons that terminate in the striatum and prefrontal cortex via CB1R activation.[8, 14] These neurons and the pathway are the basis of what mediates the rewarding and motivational properties of cannabis. Given that CB1Rs are not expressed on dopaminergic neurons, this effect is not a result of direct activation of dopaminergic neurons, but due to GABAergic interneuron activity.[15] GABA neuron activity is the primary inhibitory neurotransmitter, which means it decreases the neuron's action potential. When the inhibitory effect is not in place, the effects of cannabis are seen.[15]

The location of CB1Rs matters as it is highly concentrated in regions of the brain that are notable for increased cognition. These areas are known as the hippocampus, prefrontal cortex, anterior cingulate cortex, basal ganglia, cerebellum, and cortex.[8]

Fetal Effects

In light of this increase in maternal cannabis usage during pregnancy, few studies have been conducted to measure the fetal effects of cannabis. Fetal effects were researched due to the chemical properties of *Cannabis sativa*. Δ^9 – tetrahydrocannabinol is a lipophilic and small molecule that can cross membranes easily to be distributed to the brain and fat. In animal models, THC crossed placental barriers during gestation which may attribute to some of the reported effects in infants and potentially disrupt fetal developmental pathways [1, 11] With further research, it was found that cannabinoid receptors are present in the fetal brain, proving the biologic rationale for potential fetal effects from maternal use.[5] Though research is available regarding the transfer of cannabinoid products, limited data remains due to no randomized controlled trials.

There are a multitude of ways that maternal cannabis use during pregnancy could affect fetal growth and developments. Cannabis use can lead to intrauterine growth restriction similar to tobacco use by decreasing fetal oxygen levels from the interaction of increased carboxyhemoglobin levels in the blood and decreased maternal blood supply to the placenta. [16] There are also cannabinoid receptors present early in pregnancy and become activated in the first trimester. The cannabis metabolites can activate these receptors in the central nervous system and directly affect the brain and body by altering cannabinoid and related neurotransmitter or neuroendocrine systems.[16] Further studies have revealed that endocannabinoids bind to cannabinoid receptors in pancreatic β -cells and regulate the intracellular calcium concentration, consequently decreasing glucose-dependent insulin secretion.[17] This cellular effect could affect the fetus as insulin mediates the major fetal growth factors are insulin-like growth factor 1 and insulin-like growth factor 2.[16-18] Presumably, it may be inferred that fetuses prenatally exposed to cannabis have lower insulin levels compared with the controls, which could lead to impaired growth.[16-18] Studies have not been conducted to relate cannabis use and Diabetes Mellitus. There are also psychosocial detriments of maternal cannabis use, including maternal stress, co-use of other substances, or poor nutritional status during pregnancy, may each have contributed to differences in fetal growth between cannabis users, tobacco users, and nonusers.[19]

The reported manifestations that affect the fetus include lower birth weight without a change in head circumference and neonatal length, an increased placement in neonatal intensive care unit, and varied neurodevelopmental changes.[20] Other possible manifestations include whether there is an increase in stillbirth, spontaneous preterm birth, or impaired fetal growth.[20] However, there are conflicting findings from various research debating if those manifestations are solely from cannabis usage. In one study, birth weight was noted as a

repeated variable after analyzing ten studies. Four of those studies reported a decrease in fetal weight, while the other six studies demonstrated a null association of fetal weight and maternal cannabis usage during pregnancy.[20]

Specifically, one large prospective study known as Generation R demonstrated decreased infant growth related to cannabis use during pregnancy, likely due to a dose-dependent response. However, while this study did compare cannabis use to cigarette use and demonstrated that cannabis-related adverse outcomes are more pronounced, it did not account for concurrent cigarette use, causing a limitation to this study.[19]

The other studies aforementioned did not demonstrate a difference among cannabis users alone. There is also conflicting evidence regarding the correlation amidst cannabis use and preterm birth or intrauterine growth restriction. Previously, older studies found a significant correlation with a dose related response.[21] However, newer studies show minimal evidence regarding increased risk for preterm birth or intrauterine growth restriction in fetuses whose mother smoked cannabis during pregnancy.[22] Nonetheless, there are some studies that revealed an increased rate in neonatal adverse events such as neonatal intensive care unit admissions.[18, 19, 21] There is no data present that addresses any long-term effects to the fetus during their developmental years. A concern for congenital malformations was previously studied, but the majority of the data reported no association with maternal cannabis use during pregnancy.[22] Newer studies are emerging evidence regarding the potential of propensity of cannabis use later in the fetus' life and diminished academic capacity due to exposure to maternal cannabis use.[23] These studies have not been well established as of yet but is a growing field of interest.

Another area of interest that has been researched but with limited data is the maternal mortality and morbidity associated with cannabis use. It is known that tobacco use is associated with increased rates of preeclampsia. Therefore, a growing area of research is examining the effects of cannabis use to the placenta and relation to preeclampsia or other hypertensive disorders during pregnancy.

Compared to cannabis usage during pregnancy, research on cannabis usage postpartum is even more limited. There have been a few research studies that discussed the potential exposure of cannabis metabolites in breast milk. However, further research has not been conducted that explores the accumulation of those toxins and if these toxic metabolites cause neurodevelopmental or other organ related adverse effects. [1, 4]

Despite the large increases in cannabis usage during pregnancy and respective research studies, there have been many reported limitations in these studies attributing to the contradicting fetal manifestations of maternal cannabis usage during pregnancy. These limitations include, but are not limited to, a small sample population and no biomarker validity on maternal report of dose or gestational timing of cannabis use. Consequentially, there is limited information on maternal cannabis usage and damaging long-term fetal outcomes.[20]

Significance

With this emerging development of medical cannabis usage, there is a growing need to better understand the effects of cannabis during pregnancy and the six-month postpartum period. The American College of Obstetricians and Gynecologists (ACOG) recommends physician to encourage the discontinued use of marijuana during pregnancy “for medicinal purposes in favor of an alternative therapy for which there are better pregnancy-specific safety data.”[1]

Additionally, ACOG recommends decreasing or abstaining from maternal cannabis use during lactation or breastfeeding due to unknown long-term effects of the infant.[4] In Tarrant County, most physicians recommend breastfeeding up to six-months postpartum.[24] Therefore, providers in Tarrant county request post-partum mothers to decrease or abstain from cannabis usage up to six months postpartum if they are breastfeeding.

This underdeveloped area of research is a major concern for healthcare providers in the nation. Juggling a therapeutic relationship with a pregnant patient using marijuana while meeting mandatory reporting requirements is an arduous task for many health care providers. Developing this patient rapport becomes fastidious when there is no reliable evidence to stimulate the decision of terminating cannabis usage during pregnancy to reduce harm to the fetus.

Since clinicians are mandated to report cannabis usage, patients frequently do not report their use of cannabis. Understanding these perceptions from a patient are key in treating patients who use cannabis in pregnancy and postpartum. Patients perceive that use of cannabis in pregnancy is acceptable due to improving pregnancy side effects of nausea and mood, understanding cannabis as natural and safe, or unsure if cannabis usage produced prenatal risks since there is a lack of research.[25] Pregnant and postpartum patients perceive the lack of communication from physicians as lack of certainty on adverse prenatal or postnatal outcomes of the fetus.[4]

Rationale

Focusing on cannabis usage in pregnant or postpartum patient's perspective allows medical providers to evaluate an alternative therapy that can achieve the same or approximate effects of marijuana. There have been studies published about cannabis usage beliefs that reported increased self-report use, increased support for cannabis legalization, and patient perception of limited risks associated with cannabis usage.[25] However, few studies have been published regarding patient perceptions of cannabis usage during pregnancy or six-months postpartum.

The studies that have been published on prenatal and postnatal cannabis usage focus on patient perception of the risks of marijuana on the fetus. Patient perception of limited risk to cannabis usage during pregnancy has created a three-fold increase in the overall amount of cannabis usage, where 70% of these pregnant and non-pregnant patients believe cannabis usage once or twice a week will produce limited risk to the infant.[25, 26]

There are themes on patient perception of cannabis usage during and after pregnancy that have not been fully developed or researched. This miscommunication can be detrimental for physicians evaluating motivational interventions to address prenatal cannabis usage.[27] Such data is crucial in establishing and maintaining patient rapport regarding maternal cannabis usage, especially during this time where number of cannabis users are at an all-time high. The aims of the current study are to address the gap in the literature on patient perspectives about maternal cannabis use during pregnancy and the six-month postpartum period. Identifying these perceptions will help to understand how these drive women's decisions to use cannabis during pregnancy, and to help physicians and advanced practice providers (APP) better address prenatal and six-month postpartum cannabis use.

Materials and Methods

Study Design and Population

The study is a cross sectional cohort study of patients presenting to the Women's Health clinic at John Peter Smith (JPS) in Tarrant County. The study is approved by the Institutional Review Board (IRB), and documentation of informed consent is documented. Verbal presentation of informed consent items was required with a copy of a consent form provided to the subjects, but without the requirement of a signature. This is deemed safe as the study is minimal risk where only potential harm to the patient was a breach of confidentiality. The subject material is confidential and the only record linking the subject and the research would be the consent form, therefore, a signature would breach that confidentiality.[28]

Inclusion criteria were subjects who are presently or previously been pregnant or in a six-month postpartum period, between ages 18 till post-menopausal, and a recorded patient that is followed by an Obstetrician/Gynecologist in Fort Worth, TX. Patients who do not follow the criteria listed above will be excluded. Recruitment of the subjects occurred every weekday from September 2020 till December 2022 during randomized shifts of healthcare physicians and advanced practice providers.

Study Recruitment

English flyers were utilized to refer and recruit study participants at JPS Women's Health Clinic. In addition, subjects were approached on various days throughout the week by the Project Leader at the lobby of the JPS Women's Health clinic as the patients were waiting for their appointment. They were asked to participate in the research survey about marijuana usage during pregnancy or within six-months postpartum via the tablet.

General Study Details and Resources

Computer Screening Tools of which the patient survey and consent form are on were available in English. All patients that met the subject criteria above were included in the study. Owing to reported low numbers in other studies of concurrent cannabis, alcohol, and tobacco use, patients who used cannabis along with alcohol and tobacco were included.

Password protected tablet and/or computer were utilized in order to store data and survey response data from all subjects. All data will be deidentified with permanent intent.

Identification of Survey Subjects

In an effort to maintain the validity of the patient survey responses in this study, at least 20% of the survey had to be completed. Any subject not able to complete at least 20% of the patient survey were not included in the data analysis of patient perceptions.

Patient Perception Survey Recruitment Methodology

Subjects fitting criteria to complete the maternal cannabis usage perception survey were conducted in Fort Worth, TX. The Project Leader disseminated the patient survey and recruited study participants. Recruitment signs were displayed in various clinics throughout Fort Worth.

Survey Content and Administration

Qualitative description methodology was used for this study to capture the subject's perceptions of risks and benefits of maternal cannabis use antepartum and six-month postpartum phases. Qualitative content analysis involves combining concept-driven and data-driven analysis approaches to the text, which will be collected at the time of consent during the clinic visit.

The survey program is an electronic form that can be accessed on a tablet device. The survey program was developed on a Qualtrics Survey Software.

Marijuana timeline and quantity; demographics; co-exposure usage; and socioeconomic information about the area they live in, marital status, highest grade completed, etc. is being assessed by a selection of validated questions developed by National Health and Nutrition Survey.[29] The beginning of the survey addresses the inclusion criteria by asking if the patient is presently or has been pregnant or is in a six-month postpartum period and is older than 18. If answered yes, the study participant continued with the survey until completion. If answered no, the survey terminated by thanking the patient for participating in this questionnaire.

This study is approved by the Institutional Review Board (IRB), and informed consent was provided at the JPS Women's Health Clinic. An electronic cover letter/consent form was presented as they open the tablet with the required informed consent elements and was required to be read and accepted or not accepted by the subjects, but without the requirement of a signature. If not accepted by the subject, they did not complete the survey. The subject will read the introduction, risk/benefit, agreement to participate, confidentiality, leaving the study, and questions/concerns sections and then was prompted to click "I do not agree" to end the survey or "I agree" to participate in the Qualtrics survey at the JPS Women's Health Clinic.

The questionnaire is 38 questions that can be completed within 5-7 minutes with simple multiple-choice answers and short open-ended blanks. The multiple-choice answers will be used for closed ended questions including the questions in Table 1.

Table 1. Participant Questionnaire	
Question/Statement	Selection/Fill in the blank
Are you at or above 18 years old?	Yes or No
If you are at or above 18 years old?	Select all that apply: Currently pregnant Previously been pregnant Currently Breastfeeding for less than 6 months Previously Breastfed None of the above
Select all that apply:	Currently use marijuana Previously used marijuana None of the above
Select all that apply:	Use marijuana during any pregnancy Use marijuana any time you were breastfeeding in the first 6 months None of the above
How old were you when you first used marijuana?	Enter Age in Years _____

Have you ever smoked marijuana for at least once a month for more than one year?	Yes or No
How old were you when you began to use marijuana for at least once a month for more than a year?	Enter Age in Years _____
During the time that you smoke or smoked marijuana, how often would you usually use it?	2-3 times per month 2 times a week 3-6 times a week More than 1 time a day
What is your current age in years?	Enter Age in Years _____
What is the highest level of education you have achieved?	Less than a high school diploma High School Diploma Some College Courses College Degree Graduate Degree
What race do you identify with?	African American Asian Caucasian Hispanic Other
Are you living with the father of the baby of the most recent pregnancy?	Yes, Married Yes, Unmarried No, but he lives close by No, he lives far away I am not in contact with the father
Which of these categories best describes your total combined family income for your household for the past 12 months?	< \$25,000 \$25,000 - \$49,999 \$50,000 - \$74,999 \$75,000 - \$99,999 \$100,000 - \$149,999 \$150,000 or more
Do you believe there is any harm in marijuana use during pregnancy or while breastfeeding?	Yes Maybe No I do not know

Why do you believe there is no harm in using marijuana during pregnancy or while breastfeeding?	Please type a brief answer: _____
Did your prenatal health care provider explain the risks of marijuana?	Yes or No
Do you think your health care provider did a good job in addressing marijuana usage during pregnancy or while breastfeeding?	Yes or No
Why do you think your provider did not do a good job?	Please type a brief answer: _____
Do you believe there is harm in using marijuana in general?	Yes Maybe No I do not know
For what reasons did you use marijuana during pregnancy or while breastfeeding?	Please type a brief answer: _____
Did you seek information about prenatal and postpartum marijuana use from other resources?	Yes or No
Do you think medical marijuana should be legalized in US for medical reasons? For any reason?	Please type a brief answer: _____
Do you have any additional thoughts about marijuana usage that you would like to share?	Please type a brief answer: _____

The fill in the blanks will be utilized for questions that cannot be answered with multiple choice such as the last time the participant used cannabis, reasons why the participant was using cannabis, physician influence on maternal cannabis usage, perceived risks to the subject and her baby from maternal cannabis use, the patient's feelings about cannabis use during pregnancy and/or the six-month postpartum period, etc.[28]

Subjects were approached at the clinic during their appointment and asked to participate in the research survey about marijuana usage during pregnancy and up to six-months postpartum via the tablet or paper copy. After the patient gave verbal consent, the Project Leader gave an introduction to the patient survey by providing the patient with the electronic or paper copy of

the survey. Data was directly inputted to Microsoft Access 2019 database. The Wilcoxon Rank Sum was used to ascertain any differences in objective (n=20) answers between the two groups. All p-values will be two-sided and $p < 0.05$ will be considered statistically significant.

Results

Participants' Demographic and Household Information

As noted in Table 2, participants' mean age was 29.4 years (range 18-53 years, n=40). 35% (n = 14) participants identified as Hispanic/Latino, 30% (n=12) Black/African American, 5% (n=2) Asian, 12.5% (n=5) non-Hispanic Caucasian, and 17.5% (n=7) participants identified as other. The majority of the participants completed a high school diploma (57.5%, n=23) but did not complete college courses or obtain a college or graduate degree. A minority of the patients completed less than a high school diploma (5%, n=2). A majority of the patients identified their household income between \$25,000<\$49,999 (45%, n=18), 35% (n=14) reported a household income of <\$25,000, 15% (n=6) reported a household income of \$50,000<\$74,999, 2.5% (n=1) reported a household income of \$100,000<\$149,999, 2.5% (n=1) reported a household income of \$150,000 or more. Participants were surveyed about their living arrangements with the father of the baby. 17.5% participants reported they lived with and married to the father of the baby (n=7), 25% participants live with the father of the baby and unmarried (n=10), 15% participants do not live with the father of the baby, but he lives close by (n=6), 12.5% participants do not live with the father of the baby, and he lives far away (n=5), and 30% participants were not in contact with the father of the baby (n=12) (m=3.13, std deviation 1.522).

Characteristics	Mean or n value	Range or Percentage
Age	29.4 (SD 2.56), n=40	18-53 y
Race		
White/Caucasian	5	12.5%
Hispanic	14	45%
Asian	2	5%
Black/African American	12	30%
Other	7	17.5%
Education		
High School Diploma	23	57.5%
Some College Courses	7	17.5%
College Degree	7	17.5%
Graduate Degree	1	2.5%
Less than a high school diploma	2	5%
Household income		
<\$25,000	14	35%
\$25,000<\$49,999	18	45%
\$50,000<\$74,999	6	15%
\$75,000<\$99,999	0	0%
\$100,000<\$149,999	1	2.5%
\$150,000 or more	1	2.5%
Living Arrangements		
Living with FOB, married	7	17.5%
Living with FOB, unmarried	10	25%
Not living with FOB, lives close by	6	15%

Not living with FOB, lives far away	5	12.5%
Not in contact with FOB	12	30%

Participants' Pregnancy and Cannabis History

As noted in Table 3, The population that was surveyed were above 18 years old. 70% of the participants were currently pregnant (n=28), 52.5% participants were previously pregnant (n=21), 2.5% participants were currently breastfeeding for less than 6 months (n=1), and/or 37.5% participants previously breastfed (n=15). Furthermore, Table 3 shows the history of cannabis usage. 47.5% participants currently using marijuana (n=21) or 42.5% previously used marijuana (n=17) with a standard deviation of 0.308. Specifically, 45% participants reported marijuana use during any pregnancy (n=18) and 5% participants reported marijuana use during the first 6 months of breastfeeding (n=2). Patients were asked their age they first used marijuana (range 12-26). 52.5% participants that previously or currently smoked marijuana were asked if they smoked for at least once a month for more than one year and reported yes. (n=21, std deviation .506).

Characteristics	Mean or n value	Range or Percentage
Age when first used marijuana	16.31	12-26 y
Pregnancy History		
Currently pregnant	28	70%
Previously pregnant	21	52.5%
Currently breastfeeding for less than six months	1	2.5%
Previously breastfed	15	37.5%
Marijuana history		
Currently use marijuana	19	47.5%
Previously used marijuana	17	42.5%
Used marijuana during any pregnancy	18	45%
Used marijuana when breastfeeding for the first six months	2	5%
Continuity of Marijuana use		
Age when used marijuana for at least once a month for more than a year	18.42	14-26 y
smoked marijuana for at least once a month for more than one year?	21=yes	52.5%=yes
	19=no	47.5%=no

Participants' Cannabis Use and Understanding

Furthermore, Table 4 provides information regarding the amount of cannabis usage. 30% participants report smoking marijuana 2-3 times per month (n=12), 32.5% participants report smoking marijuana 2 times a week (n=13), 15% participants report smoking marijuana 3-6 times a week (n=6), 10% participants report smoking marijuana more than 1 time a day (n=4), and 12.5% participants reported none (n=5)(m=2.42, std deviation 1.357). Participants were also

asked if they believed there was harm in marijuana use during pregnancy or while breastfeeding and 30% participants (n=12) reported yes, 15% (n=6) reported maybe, and 55% (n=22) reported no or they did not know (m=1.98, std deviation 1.055). Participants were also asked if they believed there was harm in marijuana use in general and 10% (n=4) participants reported yes, 15% (n=6) reported maybe, and 75% (n=30) reported no or they did not know (m=2.68, std deviation .694). 55% (n=22) of the participants reported their prenatal health care provider explained the risks of marijuana (m=1.45, std deviation .504). 55% (n=22) of the participants did not believe their health care providers did a good job in addressing marijuana usage during pregnancy or while breastfeeding. 80% participants (n=32) did not seek information about prenatal and postpartum marijuana use from other resources.

Table 4. Participants' cannabis use and understanding		
Characteristics	Mean or n value	Range or Percentage
Amount of cannabis use		
2-3 times per month	12	30%
2 times a week	13	32.5%
3-6 times a week	6	15%
More than 1 time a day	4	10%
None	5	12.5%
Harm in cannabis use during pregnancy or breastfeeding		
yes	12	30%
maybe	6	15%
no	17	42.5%
I do not know	5	12.5%
Harm in cannabis use in general		
yes	4	10%
maybe	6	15%
no	29	72.5%
I do not know	1	2.5%
Prenatal care addressed cannabis usage during pregnancy or while breastfeeding?		
yes	22	55%
no	18	45%
Provider do a good job in addressing cannabis use during pregnancy or while breastfeeding?		
yes	18	45%
no	22	55%
Participants sought information about prenatal and postpartum marijuana use		
yes	8	20%
no	32	80%

Participants' Perceptions for Cannabis use and Healthcare Experience

Table 5 reveals the themes in the participants reasons as to why they used marijuana during pregnancy or while breastfeeding. Participants' responses varied regarding why they believed their health care provider did not do a good job which can be seen in Table 5. A majority of the participants (n=35) reported they believed marijuana should be legalized for medical reasons or for other reasons across the United States for a variety of reasons seen in Table 5.

Table 5. Major themes and subthemes	
Main Themes	Quotations
Reason for marijuana usage	
Calming	<p>"because it calms me down"</p> <p>"Calming"</p> <p>"helped calm me"</p> <p>"helps with pregnancy"</p> <p>"to relax"</p>
Pain reliever	<p>"helps with pain of pregnancy"</p> <p>"help with contractions"</p> <p>"pain reliever when Tylenol didn't help"</p> <p>"to help with pain"</p>
Previous use	<p>"I was always doing it"</p> <p>"ive always done it"</p> <p>"routine for me"</p> <p>"always done it and there's no risk"</p>
No reason or did not believe there was harm	<p>"just because"</p> <p>"no harm"</p> <p>"nothing wrong wit it"</p>
Participants' belief why health care provider did not do a good job	
Provider did not discuss	<p>"she did not talk about it"</p> <p>"he never went over it"</p> <p>"we never talked about it"</p> <p>"no info"</p> <p>"never talked about it"</p> <p>"never mentioned it at all"</p> <p>"didn't talk about it"</p> <p>"didn't explain everything"</p> <p>"He didn't tell me what could happen"</p>
Participant did not understand	<p>"still don't know what it can do"</p> <p>"still don't understand"</p> <p>"I don't know if its bad or good"</p> <p>"I don't know what can happen when smoking weed"</p>
Does not know	<p>"not sure"</p> <p>"didn't know"</p>
Not relevant	<p>"Because I didn't smoke"</p> <p>"I don't smoke so it was not necessary"</p> <p>"it was a long time ago"</p>
Why medical marijuana should be legalized	
Yes	<p>"Absolutely"</p>

No

"If they need it yes"

"Its not harmful"

"yes"

"yes for certain medications"

"yes I do"

"Yes i have read more good benefits than bad"

"Yes if it is beneficial for medical purposes"

"Yes, some peoples nerves calm down and helps with eyesight"

"No"

Discussion/Innovation

Our study examined the perceptions of cannabis use during pregnancy and six-month postpartum period and evaluated for the participants' understanding of the effects of cannabis use during pregnancy and six-month postpartum period. Consistent with the study results above, we demonstrated participants reporting cannabis use were more likely to be young, single, Hispanic or Black/African American females with an income less than \$50,000. The participants are also less likely to have completed some type of college degree. Our low rate of cannabis use in our largely Asian or White/Caucasian or higher educational degree female cohort is consistent with previously published reports.[30] Some co-morbidities to consider was that the populations surveyed was completed at a public Women's Health Center with a predominately Hispanic and Black/African-American population and the participants were mainly socioeconomically disadvantaged. Given that approximately half of the population reporting cannabis use was either Hispanic or Black/African American, we cannot fully exclude the possibility that our observations were due to the population at the JPS Women's Health Center rather than exogenous exposures.

This study examined the cannabis usage amongst participants that were currently versus previously pregnant and substratified into current versus prior cannabis use. A majority of the patients were currently pregnancy and currently used cannabis. Interestingly, findings from this study revealed that a majority of the participants did not believe there was harm in using cannabis during pregnancy and six-month postpartum period. There was also a common correlation between participants who were previously pregnant and previously used cannabis. In contrast to our hypothesis, there were not as many participants that smoked cannabis during the six-month postpartum period while breastfeeding. Evidently, the addictive effects of cannabis use were seen in the participants' survey answers as a majority of the participants who previously used cannabis reported they smoked marijuana for at least once a month for more than one year starting. This cannabis history could be seen at early age of 14. This prior cannabis use was an overwhelming theme as to why participants continued to use cannabis during pregnancy and/or six-month postpartum period. After discovering this correlation, it would be beneficial for healthcare providers to screen for prior cannabis use in order to effectively counsel patients.

There were not many publications regarding the amount of cannabis usage per participant and their understanding of the harm cannabis may cause. This survey asked the detailed amount of cannabis use in which a majority of the patients used cannabis at least 2-3 times per month if not more. Not many studies have reported that the increasing amount of cannabis use causes increased deleterious effects to the fetus, but something worth exploring since most of the patients that do use cannabis, use regularly. Furthermore, over 40% participants did not believe there was harm in cannabis use during pregnancy or breastfeeding and over 72.5% did not believe there was harm in cannabis use in general. The difference in percentages reveal that there is some educational component where participants believe that there is more harm in cannabis use during pregnancy or breastfeeding versus the harm in cannabis use in general. Many

women acknowledge that cannabis could be harmful to their pregnancy or infant, however cannot identify potential harms. These perceptions may be due to the current scientific uncertainty of the causal relationship between cannabis consumption and health outcomes in pregnancy and postpartum.[31] Furthermore, 55% of participants reported that their healthcare provider did address cannabis use during pregnancy or while breastfeeding up to the six-month postpartum period. However, when asked if the healthcare provider did a good job in addressing cannabis use during pregnancy or while breastfeeding in the six-month postpartum period, the participated surveyed no. Therefore, healthcare providers should continue to develop the content and the way they educate their patients to mitigate the gaps in knowledge regarding cannabis use during pregnancy and six-month postpartum period. Especially since these participants do not seek additional resources to help explain prenatal and six-month postpartum cannabis use. Research suggests that women have a desire for information regarding the effects of cannabis use during pregnancy and six-month postpartum period and when they seek professional guidance, they do not feel satisfied with the information they receive.[26]

When evaluating the perceptions behind cannabis use during pregnancy and six-month postpartum period, there were few publications that address this concept. Many of the participants revealed that they used cannabis to help “calm me down” or “to relax” during pregnancy and six-month postpartum period. Another major reason for cannabis use was to relieve the pain during pregnancy, one participant even reported that cannabis “help with contractions.” These major themes as to why participants partake in cannabis use during pregnancy and six-month postpartum phase are vital to their prenatal care as understanding their why can help healthcare providers offer another alternative. For example, to help with the contractions the provider can offer Tylenol or certain positions to help alleviate the pain. There is also a need to understand the barriers encountered in the patient/health care provider counselling process to tailor effective communication and inform training resources.[11]

We additionally sought to evaluate the disconnect between healthcare providers and patients, we analyzed the survey responses using both broad and narrow definitions of harm with cannabis usage during pregnancy and six-month postpartum period to evaluate for potentially clinically significant trends. As such, we prioritized the survey to mainly ask questions regarding cannabis use during pregnancy and postpartum use in an effort to allow for detection of clinically important trends. We believe this highlights a clinical trend toward the disconnect of understanding the effects of cannabis use during pregnancy and six-month postpartum period due to the participants’ belief why the healthcare provider did not do a good job in relaying the information. An overwhelming number of comments revolved around the provider not discussing the topic at all or the participant did not understand when the provider was explaining. Our efforts of patients understanding the effects of cannabis use during pregnancy can be seen from the difference in their perception of harm in pregnancy versus general use; however, there is still room to improve. It is essential that healthcare providers discuss the effects of cannabis use during pregnancy and six-month postpartum period in the initial prenatal visit to mitigate the disconnect between healthcare providers and patients. Our findings thus highlight the need for future research into these perceptions.

The strengths of our study include a clinically relevant female cohort and stratification of our results by race, age, and pregnancy history. The results from this study are thus potentially generalizable to a number of populations from various areas in the country. Additionally, we were able to delineate the perceptions from the patient's perspective as to why the participant used cannabis and why they believed their provider did not do a good job in relaying the harmful effects of cannabis during pregnancy or six-month postpartum period. This potentially provides new insight into a provider-patient relationship that can help foster an environment where patients can speak and ask questions about cannabis use to their provider. The data was obtained from the high-frequency, population at JPS Women's Health Center. Importantly, the data was curated not only from data collection, but from electronic surveys and direct patient questionnaires that were created by trained research personnel and not the healthcare providers that care for the patient. The utilization for the trained and unbiased research personnel using standardized methodology improved detection by allowing the patient to answer honestly and without fear of stigmatization. All participant information was confidential. Lastly, our statistical query utilizing the SPSS software allowed us to stratify the data obtained from the participant questionnaire to provide clinically applicable information from the data population.

The weaknesses of the study are inherent in research associated with survey distribution and patient-reported usage. Current research indicates that evidence of maternal cannabis usage during pregnancy and postpartum have many gaps and limitations in conducting research studies. In this study, such limitations were due to limited staff with the Institutional Review Boards (IRB) approval of Spanish documents. Therefore, the Spanish-speaking population was not included and could affect the data gathered. Other limitations include falsified information due to the legality of marijuana in certain states. In Fort Worth, state laws indicate that marijuana is illegal. Therefore, patients may not be as inclined to complete the survey due to fear of legal prosecution. Additionally, while we attempted to control for confounding factors, it is inevitable when gathering surveys of a certain population at one clinic. There remains the possibility of underreporting despite our rigorous questioning methodology in the survey.

In summary, our study analyzed the impact of participants' perspectives regarding the harm of cannabis use, alone and in combination, during pregnancy and in six-month postpartum period. We hope that the study will prompt further analysis of provider education regarding cannabis use during pregnancy and six-month postpartum period and create alternatives for patients who use cannabis. With these and other studies' future findings, healthcare providers will be able to best counsel patients regarding risks from cannabis use during pregnancy and six-month postpartum period as cannabis becomes more widely accepted.

Conclusions

Medicinal cannabis is rapidly becoming legalized and acceptable in the United States. With this increased acceptance also comes the increased usage of cannabis during pregnancy and the six-month postpartum period. However, there is limited study on prenatal and postpartum effects of cannabis on the infant. In this study, we explore women's beliefs, assumptions, and perceptions about cannabis use during pregnancy. There is varied research of known evidence of harm to childbearing women who use cannabis. The research on the deleterious effects of cannabis on the fetus is varied due to the methods of obtaining the research information that rely on self-reporting cannabis use. This type of research method often fails to adjust for significant confounding factors such as tobacco use, alcohol use, socio-economic factors, demographics, and a lack of standardized measurement outcomes.

The cannabis use perceptions of the participants recorded from the survey can assist clinicians in motivational intervention for patients using marijuana during pregnancy and the six-month postpartum period. As seen in the study, many participants reported that the health care provider did not adequately address the effects of cannabis use during pregnancy and the six-month postpartum period. The participants believed this was due to a multitude of reasons such as not explaining the effects in layman terms, or the provider did not address cannabis use during the clinic visit. The participants also stated they did not feel that the information was relevant because they did not use cannabis. These actions may cause deleterious effects to the fetus such as developmental delay or growth restriction. The lack of open discussion with health care providers about potential harms of cannabis use leave many pregnant women to manage decisions around cannabis use on their own. In addition, verbalizing patient concerns of mixed messages from healthcare providers on the effects of marijuana will aid physicians on how to communicate the effects of cannabis on pregnancy, the fetus, and the neonate. Standardizing the approach of how healthcare providers discuss cannabis use during pregnancy and the six-month postpartum period can address these participants' perspectives.

However, there are many states that have not legalized cannabis. Therefore, pregnant patients may not admit to cannabis usage due to feared repercussions, such as legal prosecution or involvement with Child Protective Services. Unreported cannabis usage during pregnancy could be detrimental for the safety of the infant. In reason, that is why assessing the patient's perspective of risks and benefits of marijuana can create an open environment where the patient is comfortable in discussing cannabis usage with the clinician. Once this discussion is initiated, the clinician and the patient can create a methodical plan on how to minimally use cannabis or another intervention that will achieve the same results. This attention to the overall health of the mother and infant would come not only potentially in the form of improved reported usage, but also in the form of a therapeutic clinician-patient relationship. Since most of the participants believe that cannabis should be legalized for medical and other reasons, being able to discuss cannabis usage will become more relevant as more states begin to legalize cannabis.

With all the chaos of clinical work such as patient education, screening, history taking, and physical exam that needs to be accomplished in a clinic visit, it is often difficult to approach these arduous conversations with patients. Besides sharing confidential information, patients find it difficult to share pertinent personal problems that highly affect their health due to concern for physicians' willingness to discuss these issues. Unfortunately, these personal problems translate into the bleak reality of resorting to illicit drugs to mediate the pain inflicted on the patient.

There is much stigma in regard to cannabis usage, and the stigma is further scrutinized when the user is a pregnant patient or recently had a baby. Decreased reporting of cannabis use during pregnancy or the six-month postpartum period can deliver debilitating consequences to the mother and infant. Posing a potentially dangerous scenario is completely avoidable. According to various studies, the rapid growth of differences in legality of cannabis usage across the nation is a continuous theme in patient perceptions.[4] These changes in legal landscape of cannabis usage warrant constant evaluation of maternal cannabis use and patient perceptions.

With the reporting of patient perspectives, the stigma may shift into understanding. As legalization of marijuana continues, the legal implications have begun to fade. Due to this decrease in legal issues, many more women have started to self-report cannabis usage. Unfortunately, this is not after seeing the gap in physician reported maternal cannabis usage versus research reported maternal cannabis usage. With this patient survey, pregnant patients might become more open in reporting cannabis use. In return, these patients will receive the appropriate care and interventions they deserve.

Incorporating the framework of ethical concerns of maternal cannabis use during pregnancy or the six-month postpartum period, will help navigate the difficult conversations of reporting substance use. This study hopes to advocate for pregnant or new mothers in extrapolating the perspective of risks versus benefits to relay to clinicians for a therapeutic relationship and optimization of care. In the healthcare field, the primary goal is establishing a healthcare team that the patient has a voice in. There are limited studies on relationship between cannabis use and prenatal effects, therefore, in conducting this research we will be bridging a gap in information that is required to better educate our patients.

Compliance

This research study was conducted under the supervision and guidance of my mentor, Dr. Shanna Combs, who is an Obstetrician/Gynecologist (OB/Gyn) at the John Peter Smith hospital. All patients who were evaluated in this study were followed by an OB/Gyn at the clinics that participate in the patient survey. Requested resources included two tablets to obtain patient data in conducting the survey. In addition, study computers were requested for data storage and analysis. The backup method of paper copy was obtained. Any off-site visualization, entry, or analysis of data occurred privately within my residence in Fort Worth.

References

1. *Committee Opinion Summary NO. 722: Marijuana Use During Pregnancy and Lactation.* Obstet Gynecol, 2017. **130**(4): p. 931-932.
2. El Marroun, H., et al., *An epidemiological, developmental and clinical overview of cannabis use during pregnancy.* Prev Med, 2018. **116**: p. 1-5.
3. Yu, B., et al., *Marijuana legalization and historical trends in marijuana use among US residents aged 12-25: results from the 1979-2016 National Survey on drug use and health.* BMC Public Health, 2020. **20**(1): p. 156.
4. Barbosa-Leiker, C., et al., *Daily Cannabis Use During Pregnancy and Postpartum in a State With Legalized Recreational Cannabis.* J Addict Med, 2020. **14**(6): p. 467-474.
5. Chabbarria, K.C., et al., *Marijuana use and its effects in pregnancy.* Am J Obstet Gynecol, 2016. **215**(4): p. 506 e1-7.
6. Cameron, L.D., et al., *Beliefs about marijuana use during pregnancy and breastfeeding held by residents of a Latino-majority, rural region of California.* J Behav Med, 2022. **45**(4): p. 544-557.
7. El Marroun, H., et al., *Demographic, emotional and social determinants of cannabis use in early pregnancy: the Generation R study.* Drug Alcohol Depend, 2008. **98**(3): p. 218-26.
8. Rabin, R.A. and T.P. George, *A review of co-morbid tobacco and cannabis use disorders: possible mechanisms to explain high rates of co-use.* Am J Addict, 2015. **24**(2): p. 105-116.
9. Alcala, E., R. Cisneros, and J.A. Capitman, *Health care access, concentrated poverty, and pediatric asthma hospital care use in California's San Joaquin Valley: A multilevel approach.* J Asthma, 2018. **55**(11): p. 1253-1261.
10. Fishbein, D.H., et al., *Mediators of the stress-substance-use relationship in urban male adolescents.* Prev Sci, 2006. **7**(2): p. 113-26.
11. Weisbeck, S.J., et al., *Perceptions about cannabis use during pregnancy: a rapid best-framework qualitative synthesis.* Can J Public Health, 2021. **112**(1): p. 49-59.
12. Mark, K., A. Desai, and M. Terplan, *Marijuana use and pregnancy: prevalence, associated characteristics, and birth outcomes.* Arch Womens Ment Health, 2016. **19**(1): p. 105-11.
13. van Gelder, M.M., et al., *Characteristics of pregnant illicit drug users and associations between cannabis use and perinatal outcome in a population-based study.* Drug Alcohol Depend, 2010. **109**(1-3): p. 243-7.
14. Compton, D.R., et al., *Pharmacological profile of a series of bicyclic cannabinoid analogs: classification as cannabimimetic agents.* J Pharmacol Exp Ther, 1992. **260**(1): p. 201-9.
15. Pistis, M., et al., *Delta(9)-tetrahydrocannabinol decreases extracellular GABA and increases extracellular glutamate and dopamine levels in the rat prefrontal cortex: an in vivo microdialysis study.* Brain Res, 2002. **948**(1-2): p. 155-8.
16. Harkany, T., et al., *The emerging functions of endocannabinoid signaling during CNS development.* Trends Pharmacol Sci, 2007. **28**(2): p. 83-92.
17. Bermudez-Silva, F.J., et al., *Presence of functional cannabinoid receptors in human endocrine pancreas.* Diabetologia, 2008. **51**(3): p. 476-87.

18. Gluckman, P.D. and C.S. Pinal, *Regulation of fetal growth by the somatotrophic axis*. J Nutr, 2003. **133**(5 Suppl 2): p. 1741S-1746S.
 19. El Marroun, H., et al., *Intrauterine cannabis exposure affects fetal growth trajectories: the Generation R Study*. J Am Acad Child Adolesc Psychiatry, 2009. **48**(12): p. 1173-81.
 20. Gunn, J.K., et al., *Prenatal exposure to cannabis and maternal and child health outcomes: a systematic review and meta-analysis*. BMJ Open, 2016. **6**(4): p. e009986.
 21. Hayatbakhsh, M.R., et al., *Birth outcomes associated with cannabis use before and during pregnancy*. Pediatr Res, 2012. **71**(2): p. 215-9.
 22. Shiono, P.H., et al., *The impact of cocaine and marijuana use on low birth weight and preterm birth: a multicenter study*. Am J Obstet Gynecol, 1995. **172**(1 Pt 1): p. 19-27.
 23. Sonon, K.E., et al., *Prenatal marijuana exposure predicts marijuana use in young adulthood*. Neurotoxicol Teratol, 2015. **47**: p. 10-5.
 24. Radzimirski, S. and L.C. Callister, *Mother's Beliefs, Attitudes, and Decision Making Related to Infant Feeding Choices*. J Perinat Educ, 2016. **25**(1): p. 18-28.
 25. Chang, J.C., et al., *Beliefs and attitudes regarding prenatal marijuana use: Perspectives of pregnant women who report use*. Drug Alcohol Depend, 2019. **196**: p. 14-20.
 26. Ko, J.Y., et al., *Prevalence and patterns of marijuana use among pregnant and nonpregnant women of reproductive age*. Am J Obstet Gynecol, 2015. **213**(2): p. 201 e1-201 e10.
 27. Jarlenski, M., et al., *Pregnant Women's Access to Information About Perinatal Marijuana Use: A Qualitative Study*. Womens Health Issues, 2016. **26**(4): p. 452-9.
 28. Davis, J.M., L. Yao, and B.E. Bierer, *Protecting Pregnant Women With Substance Use Disorders and Their Neonates Participating in Research*. JAMA, 2019. **322**(7): p. 609-610.
 29. Bradley, H., et al., *Use of Population-Based Surveys for Estimating the Population Size of Persons Who Inject Drugs in the United States*. J Infect Dis, 2020. **222**(Suppl 5): p. S218-S229.
 30. Stinson, F.S., et al., *Cannabis use disorders in the USA: prevalence, correlates and comorbidity*. Psychol Med, 2006. **36**(10): p. 1447-60.
 31. Volkow, N.D., W.M. Compton, and S.R. Weiss, *Adverse health effects of marijuana use*. N Engl J Med, 2014. **371**(9): p. 879.
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