The Use of Cannabis During Pregnancy

Policy Brief

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Issue: Is the consumption of cannabis safe during pregnancy?

Background: The legalization of recreational cannabis in 2018 and medical cannabis in 2001 is rapidly changing the social landscape of Canada. Once considered an illicit drug, cannabis is quickly growing in acceptance and accessibility among Canadians. This policy brief examines the safety of cannabis use among a specific segment of Canada's population—pregnant women. This issue is of paramount importance for two primary reasons. First, like women in the general population, pregnant women are increasingly using cannabis. Second, there is a growing perception not only among women in the general population, but also among pregnant women that cannabis use is safe, even during pregnancy. Patterns of increased cannabis consumption and the perception of cannabis as safe by pregnant women are problematic because of the potential effects on the health and well-being of the fetus during pregnancy and child in the long-term.

Findings: While some studies have found adverse neonatal outcomes after exposure to maternal cannabis during pregnancy, the evidence on the specific effects of cannabis use during pregnancy on the mother, fetus and child is both limited and inconsistent. More research is needed to establish the short- and long-term effects of prenatal cannabis use, independent of other substances such as tobacco. This evidence is urgently needed given the rising prevalence of cannabis use disorder (CUD) among pregnant women, which may pose even more serious risks. Despite the limitations of the existing literature, what is clear thus far is that no evidence establishes that a "safe" quantity of cannabis can be consumed without affecting the health and well-being of the fetus and child, and the potential adverse consequences on offspring likely outweigh any potential therapeutic benefits to the mother. This is consistent with the clinical guidelines and policy recommendations of key Canadian, American and international health bodies, which recommend avoiding the consumption of cannabis during pregnancy.

Policy Implications: Accessing reliable and reputable information regarding the effects and safety of cannabis remains a significant challenge for the public due to the lack of clear, evidence-based guidelines from policymakers and healthcare providers. Misinformation has helped to fuel misperceptions that the consumption of cannabis during pregnancy is safe and effective for treating various pregnancy-related needs or conditions. Healthcare professionals, particularly frontline healthcare workers, play a vital role in reducing this knowledge gap by educating the public and expectant mothers with adequate and reliable information about the potential risks associated with cannabis consumption during pregnancy and postpartum. This will require policymakers to provide the necessary resources and take an active role in the collection, analysis and sharing of evidence to ensure healthcare professionals are aware and knowledgeable about the latest developments in the field, which will enable them to provide patients with the appropriate evidence-based information and supports necessary to make informed decisions regarding their health and the health of their child(ren). Knowledge mobilization efforts are particularly important for developing effective prevention and intervention

programs for cannabis-related disorders such as CUD, which are expected to be more prevalent with the rising social acceptance of cannabis following legalization.

Conclusion: Canada's growing cannabis market is still in its infancy, and little is known about the safety and specific health effects of cannabis consumption, particularly during pregnancy. As the cannabis market evolves and matures, so will our understanding of the associated risks and potential benefits of cannabis in all of its various forms and types. Policymakers and healthcare professionals will play a pivotal role in helping to address existing knowledge gaps by promoting more evidence-based research, educating the public and counseling patients on the effects of cannabis use and exposure during pregnancy – as they have with alcohol and tobacco – to ensure informed decisions are made that promote the health and well-being of all Canadians.

Policy Brief: The Use of Cannabis During Pregnancy

1.0 Introduction

In 2018, Canada became the second country [1] to legalize non-medical (recreational) cannabis at the federal level, several years after the legalization of medical cannabis in 2001. Once considered an illicit drug, cannabis is becoming much more acceptable and accessible among Canadians, and its legalization is rapidly changing the social landscape of the country. Canada's bourgeoning cannabis industry, which is on par with the beer industry and larger than the tobacco industry in terms of the market size (Government of Canada [GC], 2018b), is being fueled by Canadians' growing appetite for not only traditional dried plant-based cannabis but also alternative forms of cannabis such as edibles, oils, extracts, sprays and creams.

Cannabis consumption has increased in Canada in the last decade, from approximately 11% of the general population in 2009 to approximately 17% in 2019, following the legalization of recreational cannabis (StatCan, 2019). An increase in first-time users of cannabis is helping to fuel the demand for cannabis. In the first quarter of 2019, an estimated 646,000 cannabis users reported trying cannabis for the first time — almost twice the corresponding estimate of 327,000 users in 2018 when recreational cannabis use was not yet legal (StatCan, 2019). According to Statistics Canada, the number of legal cannabis stores across the country also increased nearly eightfold from the end of 2018 to the end of 2020 (Rotermann, 2021). The growing perception of cannabis as a "safe" drug has been pivotal in fueling demand.

This policy brief examines the safety of cannabis use among a specific segment of Canada's population — pregnant women. This issue is of paramount importance for two central reasons. First, like women in the general population, pregnant women are increasingly using cannabis. Second, there is a growing perception not only among women in the general population, but also among pregnant women that cannabis use is safe, even during pregnancy. Patterns of increased cannabis consumption and the perception of cannabis as safe by pregnant women are problematic because of the potential effects on the health and well-being of the fetus during pregnancy and child in the long-term. Given the recency of policies legalizing cannabis in Canada and some U.S. states, the impact of legalization on cannabis use and perceptions among pregnant women is not yet clear. Further research is needed to better understand the effects of various forms of cannabis use during pregnancy following its legalization. More effective knowledge mobilization of the available research evidence is also a priority need.

2.0 Methods

The following electronic databases were searched through December 2021 to identify articles relevant to the issue of cannabis and pregnancy: EBSCO (interdisciplinary peer reviewed journals); JSTOR (interdisciplinary peer reviewed journals); OVID (Medline, PsycINFO, Health and Psychosocial Instruments); ProQuest; PubMed; SCOPUS; Web of Science; and Google Scholar. In addition, the websites of relevant associations, institutions and government bodies were identified and searched in the collection of grey literature which included: government publications; white papers; and working papers. A hand search of the reference lists of relevant previous reviews was also conducted to supplement the initial literature searches with any records that may have been overlooked. Although the review focused on the use of cannabis in Canada, the literature search

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[1] Uruguay was the first country to legalize nonmedical cannabis in 2013.

was broadened to include studies from other countries that have legalized the use of cannabis and/or have significant populations of cannabis users.

The following keywords were used as search terms: cannabis, marijuana, pregnancy, breastfeeding, risk, Canada, child, and fetus. The list of keywords was developed on the basis of existing reviews and modified for purposes of the review. Keywords were adapted to meet the search parameters of the individualized databases. Sources were included in the literature review if they were found to contain variables of interest and keywords relevant to the research question and objectives.

3.0 Understanding Cannabis

3.1 What is Cannabis?

Cannabis refers to products derived from the plant *Cannabis Sativa* which contains hundreds of chemical substances, the most recognized being cannabinoids (Government of Canada [GC], 2019a). Cannabinoids affect cell receptors in both the brain and body by altering patterns of communication between these cells. Two of the most researched cannabinoids are delta-9-tetrahydrocannabinol (THC) and cannabidiol (CBD):

- **THC** is the chemical primarily responsible for the psychoactive, high and intoxicating effects of cannabis. THC acts on a system in the body and brain called the endogenous cannabinoid system (endocannabinoid system), which plays an important role in regulating many body functions, such as sleep, appetite, immune response, and pain. The way in which THC interacts with the receptors in this system determines the physical and psychological effects on the body and mind (Almogi-Hazan & Or, 2020). The potency of THC in cannabis is often shown as a percentage of THC by weight or by volume of oil (GC, 2019a). Over the years, the potency of THC in cannabis, particularly dried cannabis, has increased from an average of 3% in the 1980s to approximately 15% or as high as 30% in some strains (GC, 2019a). When cannabis contains very low amounts of THC in its flowers and leaves (i.e., less than 0.3%), it is classified as hemp (GC, 2019a).

- Derived from the hemp plant, **CBD**—unlike THC—does not produce a high or intoxication (GC, 2019a). While CBD also acts on the endocannabinoid system, the exact nature of this interaction is not yet well understood. Studies suggest that CBD may stimulate the release of the body's own endocannabinoids rather than binding to receptors as THC does (OCSa, n.d.). There is some evidence that CBD may block or lessen the effects of THC on the brain when the amount of CBD in cannabis is equal to or higher than the amount of THC (GC, 2019a).

- Terpenes are chemicals found in the cannabis plant that give cannabis its distinctive smell and taste and help to differentiate between the different strains of cannabis (GC, 2019a, Ontario Cannabis Store [OCS], 2019). There are over 100 identified terpenes unique to the cannabis plant, the most common being: myrcene; pinene; limonene; linalool; and beta-caryophyllene (OSC, 2019). There are suggestions that terpenes, often associated with various types of plants and herbs used in naturopathic remedies, may play a therapeutic role in the effect of cannabis; however, there is no scientific evidence that has shown that terpenes do more than enhance scent and flavour (OSC, 2019).

3.2 Effects of Cannabis

Since every individual has a different physiological makeup including the composition of their endocannabinoid system, the effects of cannabis are different for every user (OCSb, n.d.). In some cases, individuals may experience very different effects on different occasions and/or throughout their lives (Alcohol and Drug Foundation [ADF], 2019a). Factors that may impact the effects of THC on individuals include: age, size, weight and health of the user; frequency of use; the route of administration; whether cannabis is taken with other drugs and/or alcohol; quantity consumed; the potency of cannabis; environmental factors; history of mental illness; and an individual's personality (ADF, 2019a; Australian Institute of Health and Welfare, 2017; Grant & Bélanger, 2017; Parrott et al., 2004; Green, Kavanagh & Young, 2009).

Factors Affecting the Effects of Cannabis

➢ User Age, Size, Health and Weight
➢ Frequency of Use
➢ Method of consumption (smoking, vaping, oral, topical)
➢ Consumption with Other Drugs/Alcohol
➢ Quantity Consumed
➢ Cannabis Potency
➢ Environmental Factors
➢ History of Mental Illness
➢ Personality

The effects of cannabis can be felt immediately, within seconds to minutes of smoking, vaporizing or dabbing cannabis and can last for up to 24 hours (GC, 2019a). If cannabis is consumed by eating or drinking, effects can occur within 30 minutes to 2 hours and can last up to 24 hours (GC, 2019a).

Short-term or acute effects of cannabis can include: effects on mood (i.e., feeling high (euphoria); a sense of well-being; relaxation; or dysphoria, including anxiety and panic); effects on the brain, cognition and perception (i.e., confusion; fatigue; impaired memory; inability to concentrate; altered temporal and spatial perception; and heightened senses, including sight, taste, smell and sound); effects on the body (i.e., impaired motor performance; slowed reaction time; damaged blood vessels caused by smoking cannabis; decreased blood pressure, which can cause people to faint; and increased heart rate, which can lead to an increased risk of heart attack); sedative effects; and subjective feelings of discomfort and lethargy (GC, 2019a; Ashton, 1999; Hartman & Huestis, 2013). Psychotic episodes characterized by paranoia, delusions and hallucinations have also been identified with cannabis use (GC, 2019a).

Long-term or chronic effects of cannabis use depend on the quantity, frequency and duration of cannabis consumption, and in some cases, how cannabis is consumed (ADF, 2019a; Chan et al., 2017; Campbell, 2000). Effects can last from a few days to months or longer and may not be reversible even when an individual stops using cannabis (GC, 2019a). The long-term effects of regular cannabis use in some individuals may also be affected by the development of tolerance to the behavioural and pharmacological effects (Ashton, 1999). Some of the potential effects of long-term or heavy cannabis use can include: an increased risk of developing psychiatric disorders such as schizophrenia; (Grant & Bélanger, 2017; Di Forti et al., 2014; Large et al, 2011), harm to brain

functioning including: neuropsychological decline [2]; reduced memory; concentration; and ability to think and make decisions; and cannabis use disorder (see Section 3.3) (GC, 2019a; Meier et al., 2012). Chronic cannabis use can also affect other body systems. For example, the other constituents in smoke from a cannabis cigarette have similar respiratory effects as smoking tobacco, such as bronchitis, asthma, lung infection, chronic cough, cancer, and increased mucus buildup in the chest (GC, 2019a; Ashton, 1999).

3.3 Cannabis-Related Disorders

There is clear evidence that regular cannabis use can lead to addiction in the long term. Evidence from the US indicates that approximately 9% of all cannabis users will become addicted at some point in their life; and this risk is higher for those who start using cannabis earlier in life (Lopez-Quintero et al., 2011). Specifically, estimates indicate that one in six cannabis users who initiate use in adolescence will become addicted (Hall & Degenhardt, 2009).

Cannabis abuse, dependence, or addiction is now known as **cannabis use disorder (CUD)**, which refers to the continued use of cannabis despite the associated impairment in psychological, physical, or social functioning (Patel & Marwaha, 2021). According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), [3] CUD is defined as significant impairment or distress from cannabis use, as manifested by two or more of the following within a 12-month period: (Patel & Marwaha, 2021):

- Cannabis is often taken in larger amounts or over a longer period than was intended,
- There is a persistent desire or unsuccessful efforts to cut down or control cannabis use,
- A great deal of time is spent in activities necessary to obtain cannabis, use cannabis, or recover from its effects,
- Craving, or a strong desire or urge to use cannabis,
- Recurrent cannabis use results in failure to fulfill role obligations at work, school, or home,
- Continued cannabis use despite having persistent or recurrent social or interpersonal problems caused or exacerbated by the effects of cannabis,
- Important social, occupational, or recreational activities are given up or reduced because of cannabis use,
- Recurrent cannabis use in situations in which it is physically hazardous,
- Cannabis use continues despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by cannabis,
- Tolerance, as defined by either: (1) a need for markedly increased cannabis to achieve intoxication or desired effect or (2) a markedly diminished effect with continued use of the same amount of the substance, and
- Withdrawal, as manifested by either (1) the characteristic withdrawal syndrome for cannabis or (2) cannabis is taken to relieve or avoid withdrawal symptoms.

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[2] Neuropsychological functioning was assessed in using cognitive testing over a period of 20 years, before and after participants had developed a persistent pattern of cannabis use. Participants with more persistent cannabis dependence showed greater IQ decline and greater impairment across five domains of neuropsychological functioning (Meier et al., 2012).

[3] Prior to the DSM-5, cannabis use disorder was defined by two separate diagnostic criteria – abuse and dependence. The DSM-5 revised the definition according to the criteria listed and graded the severity as either mild, moderate, or severe, depending on how many criteria are present. Evidence indicates that the single dimension measure of CUD used in the DSM-5 may be more sensitive to capturing changes in CUD prevalence than the separate categories in the DSM-4 (Compton et al., 2019).

In the US, survey data has shown the prevalence of CUD among all adults in the population to be approximately 1.5-2.9%, while the prevalence among past-year cannabis users is higher (12-31% among adults and 20-25% among adolescents) (Jutras-Aswad et al., 2018). More recently, longitudinal data from the National Surveys on Drug Use and Health from 2002-2017 indicates that the overall prevalence of CUD according to the DSM-5 criteria increased over this period, from 2.1% to 2.6% among all adults – largely driven by an increase in mild CUD (the presence of two or three of the above criteria) (Compton et al., 2019). However, among adult cannabis users, the prevalence of CUD appeared to decrease from 20% in 2002 to 17% in 2017. Looking at individual diagnostic criteria, this study found declining prevalence in all criteria except for tolerance, which remained stable (Compton et al., 2019).

Heavy or prolonged cannabis use can also lead to withdrawal after cessation in a subset of users – the severity of which depends on the frequency and recency of use (Patel & Marwaha, 2021). As defined by the DWS-5, **cannabis withdrawal syndrome** (CWS [4]) usually appears within one week after cessation of cannabis use and is characterized by three or more of the following symptoms (Katz et al., 2014: 271; Patel & Marwaha, 2021):

- irritability, anger or aggression;
- nervousness or anxiety;
- sleep difficulty;
- decreased appetite or weight loss;
- restlessness;
- depressed mood; and
- at least one somatic symptom causing significant discomfort (i.e.,abdominal pain, shakiness or tremors, sweating, fever, chills, headache).

3.4 Consumption and Forms of Cannabis

Cannabis can be consumed in a multitude of ways. Traditionally, cannabis is consumed by smoking in cigarette form or through a pipe; however, other forms of consumption have grown in popularity including: edibles, which can be eaten in the form of baked goods, candy and other confectionaries; liquids, such as tea, beer and soda infused with cannabis; cannabis vapours, which involve breathing in dried or liquid cannabis vapours using a vaping device; dabbing, involving breathing hot vapours from heating cannabis concentrates; and creams or oils that can be applied topically (Canadian Centre on Substance Abuse and Addiction [CCSA], 2019; GC, 2019a; Lung Health Foundation, 2018: 10). Cannabis also comes in many different forms with varying levels of potency. Table 1 identifies the different forms of cannabis and their THC potency.

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[4] Both CUD and CWS are recognized by the American Psychiatric Association as substance-related and addictive disorders (American Psychiatric Association, DSM-5 Task Force, 2013).

Table 1: Different Forms of Cannabis

Form	Description	THC Potency
Fresh or dried herbal material[1]	Flowers and leaves from the cannabis plant.	Up to 30%
Cannabis oil[1]	Cannabis extract dissolved in oil. Can be used to make other forms of cannabis such as edibles.	Up to 3%
Chemically concentrated extracts (e.g. hash oil/shatter/ budder/wax[1]	Highly concentrated cannabis extract dissolved in petroleum-based solvent (e.g. butane). Shatter, budder and wax most highly concentrated.	Up to 90%
Physically concentrated extracts (e.g. hash/kief)[1]	Loose trichomes or pressed resin from the cannabis plant.	Up to 60%
Edibles[1]	Foods and drinks containing extracts of cannabis.	Depends on the amount of extract added
Tinctures/sprays[1]	Cannabis extract dissolved in a solvent, often alcohol. Can be used to make other cannabis products such as edibles.	Varies
Creams/salves/liniments[1]	Cannabis extract preparation prepared with alcohol, oil or wax and applied to the skin.	Varies
Synthetic[2]	Synthetic cannabis is a new psychoactive substance designed to mimic or produce similar effects to cannabis. Commonly smoked and is sometimes drunk as a tea.	Limited research on its safety and composition, potency varies

Sources:
[1] Government of Canada. (2019a). About Cannabis. Ottawa, Ontario: Government of Canada. Retrieved from https://www.canada.ca/en/health-canada/services/drugs-medication/cannabis/about.html
[2] Alcohol and Drug Foundation. (2019b). Synthetic Cannabis. North Melbourne, Victoria: Alcohol and Drug Foundation. Accessible at <https://adf.org.au/drug-facts/synthetic-cannabis/>

3.5 Recreational vs. Medical Cannabis

Cannabis use can be categorized as either recreational or medical. The use of cannabis for medicinal purposes, which was legalized in 2001, requires a prescription from an authorized health professional or can be grown for personal consumption with an approved license from Health Canada (see Section 4.2). Recreational cannabis is used without medical justification and, as of 2018, can be legally purchased through licensed provincial dispensaries across Canada. Recreational cannabis generally has a higher THC content, providing users with a "high" associated with cannabis use. In contrast, users of medical cannabis typically do so for therapeutic reasons, often to alleviate pain or disease symptoms while minimizing intoxication; therefore, medical cannabis generally has a higher CBD content, which lessens the psychoactive effects associated with recreational cannabis. Given that medical cannabis users are often using it to treat chronic conditions, the frequency of consumption has been shown to be higher among medical users compared to recreational users (Turna et al., 2020).

Table 2 provides a brief summary of the key differentiating characteristics of recreational and medical cannabis.

Table 2: Recreational vs. Medical Cannabis in Canada

	Recreational Cannabis	Medical Cannabis
Legalization	2018	2001
Use	Personal Use; "High"	Medicinal Use; Therapeutic
Authorization Required	No	Yes, authorized by a healthcare professional for use in treating and managing illness.
Access	Licensed provincial dispensaries across Canada.	Access to medical cannabis is regulated by the federal government. Can only be obtained through a federally licensed retailer, upon authorization by a healthcare professional. Can be grown by authorized users, or their official designate, who are licensed by Health Canada.
Composition	Generally has higher THC content than medicinal cannabis.	Medical cannabis generally has a higher CBD content and lower THC content.
Source: Government of Ontario. (2017). Smoke-Free Ontario Act, 2017. Get the Facts: The Difference Between Recreational Cannabis and Medical Cannabis. Toronto, Ontario: Government of Ontario. Retrieved from https://www.rcdhu.com/wp-content/uploads/2018/10/Info-sheet-Rec-vs-Med-Cannabis-October-17-2018.pdf		

Evidence on the effects of medical cannabis from Canada

In their 2018 review of the evidence on medicinal cannabis use, the Government of Canada (2018e) found that although there are numerous anecdotal accounts regarding the therapeutic applications of cannabis, there are a limited number of clinical studies supporting both the safety and efficacy of cannabis for therapeutic purposes across different medical conditions. However, research examining medicinal cannabis use in Canada is rapidly expanding, with an increasing number of clinical trials underway since the legalization of cannabis.

Based on the available evidence, the Government of Canada (2018e) identified a number of potential therapeutic uses of cannabis that include: palliative care; improving quality of life; pain management; and treating various conditions and disorders such as chemotherapy-induced nausea, vomiting and pain; wasting syndrome and loss of appetite in AIDS; psychiatric disorders, includinganorexia nervosa; multiple sclerosis, amyotrophic lateral sclerosis, spinal cord injury and disease; epilepsy; arthritides and musculoskeletal disorders; movement disorders; glaucoma; asthma; hypertension; stress; Alzheimer's disease and dementia; gastrointestinal system disorders; anti-neoplastic properties; and atherosclerosis. Despite these potential therapeutic purposes, the review published by the Government of Canada (2018e) also includes precautions against the use of cannabis in some patients, noting that cannabis is not recommended in women of childbearing age as well as those planning pregnancy (men and women) and those who are pregnant or breastfeeding.

Evidence on the effects of medical cannabis from the United States

In 2017, the U.S. National Academies of Sciences, Engineering and Medicine (NASEM) [5] released the results of their study, *The Health Effects of Cannabis and Cannabinoids: The Current State of Evidence and Recommendations for Research*. NASEM gathered and analyzed scientific evidence from systematic reviews, meta-analyses and selected high-quality primary research examining the health effects and possible therapeutic benefits of cannabis and cannabinoids on a variety of conditions and their associated symptoms. [6] The committee arrived at nearly 100 different research conclusions (NASEM, 2017: S5) regarding the efficacy of cannabis and cannabinoids ranging from substantial to insufficient or no effects in the treatment of specific health conditions (NASEM, 2017: 13-21). The main findings on the therapeutic effects were that cannabinoids are effective for treating chronic pain; chemotherapy-induced nausea and vomiting; and improving multiple sclerosis symptoms. For these conditions, the evidence was substantial, although the effects of cannabinoids were still considered to be modest; for all other conditions examined, the evidence on therapeutic effects was rated as moderate or limited (NASEM, 2017: Chapter 4). Appendix A provides a summary of these conclusions from the NASEM (2017) study; and other report conclusions on the prenatal health effects are discussed in Section 8.2.

4.0 The Legalization of the Sale and Distribution of Cannabis in Canada

On October 17, 2018, the *Cannabis Act* [7] (Bill C-45) came into force, legalizing the sale and distribution of cannabis in Canada. The purpose of the *Cannabis Act* is to protect public health and safety through measures such as restricting youth access to cannabis, providing safe and legal access to a quality-controlled supply of cannabis to adults, and enhancing public awareness of the health risks associated with cannabis use (Government of Canada, 2018h).

The *2018 Cannabis Act* provides the legal framework for the production, distribution, and possession of cannabis in Canada but grants provincial and territorial governments responsibility for retail sales and distribution within their respective jurisdictions. This includes how cannabis can be sold, where stores may be located and how stores must be operated (GC, 2019b; 2018a). Provincial and territorial governments are also granted the power to add restrictions on the use and distribution of cannabis, including: lowering possession limits; increasing the minimum age; restricting where cannabis may be used in public; and setting added requirements on personal cultivation (GC, 2019b; 2018a).

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[5] NASEM consists of experts in the areas of marijuana, addiction, oncology, cardiology, neurodevelopment, respiratory disease, pediatric and adolescent health, immunology, toxicology, preclinical research, epidemiology, systematic review, and public health.

[6] Listed in the order as they appear in the report, the committee examined the following conditions: chronic pain; treatment of chemotherapy-induced nausea and vomiting; multiple sclerosis spasticity symptoms; sleep disorders; increasing appetite and decreasing weight loss associated with HIV/AIDS; symptoms of Tourette syndrome; anxiety and associated symptoms; post-traumatic stress disorder; effects of traumatic brain injury; symptoms of dementia; glaucoma; cancers; symptoms of irritable bowel syndrome; epilepsy; spasticity in patients with paralysis due to spinal cord injury; symptoms associated with amyotrophic lateral sclerosis; Huntington's disease; motor system symptoms associated with Parkinson's disease or the levodopa-induced dyskinesia; dystonia; addiction; and mental health outcomes in individuals with schizophrenia or schizophreniform psychosis.

[7] Cannabis Act (S.C. 2018, c. 16). Accessible at https://laws-lois.justice.gc.ca/eng/acts/C-24.5/index.html.

Subject to provincial or territorial restrictions, the *2018 Cannabis Act* permits adults who are 18 years of age or older [8] to legally:

- possess up to 30 grams of legal cannabis, dried or equivalent in non-dried form in public;
- share up to 30 grams of legal cannabis with other adults;
- buy dried or fresh cannabis and cannabis oil from a provincially-licensed retailer;
- in provinces and territories without a regulated retail framework, individuals are able to purchase cannabis online from federally-licensed producers;
- grow, from licensed seed or seedlings, up to 4 cannabis plants per residence for personal use; and
- make cannabis products, such as food and drinks, at home as long as organic solvents are not used to create concentrated products (Government of Canada, 2019b; 2018a).

4.1 Legalization of Cannabis Edibles, Extracts and Topicals

The sale of edible cannabis products, extracts and topicals became legal in October 2019, approximately one year after the *2018 Cannabis Act* came into force. On June 14, 2019, the Government of Canada (2019d) announced amendments to the *2018 Cannabis Act* outlining the legal framework for producing and selling edible cannabis, cannabis extracts and cannabis topicals. According to the Government of Canada (2019d), the amendments were designed to reduce the unique health risks associated with these types of products while ensuring that Canadians have access to a broad range of cannabis products, thereby discouraging the production and sale of such products in the black market. In consideration of the unique health risks posed by these products, Canada set a regulatory precedent by setting a limit of no more than 10mg of THC in each edible product (Mahamad et al., 2020). The province of Quebec has restricted the sale of edible cannabis products even further by banning most forms of edibles that may appeal to youth (i.e. candy, confectionery, chocolates). In addition, while licensed producers were able to submit their products to Health Canada beginning in October 2019, they were subjected to a 60 to-90-day approval process, meaning that edible products became available to consumers beginning in December 2019.

Edibles are perceived as a safe means to attaining the same effects of smoking cannabis without some of the potential harms associated with inhalation; however, the delayed onset of the drug's effects with ingestion *may* prove that edibles pose a higher health risk than initially believed (Lung Health Foundation, 2018: 10). For instance, cannabis users who are unaware of the delayed

response of consuming edibles may ingest a greater amount of cannabis than intended before the full effects take hold, resulting in undesirable effects associated with excessive consumption and overdoses (Lung Health Foundation, 2018: 10). Edibles also pose a significant risk to children, who may unintentionally consume products that they believe to be food or candy. Evidence from a study by the Canadian Paediatric Surveillance Program (CPSP) in 2019 found that one-third of all cases of serious or life-threatening events or injuries to children and youth under age 18 due

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[8] In most provinces, the legal age is 19 years old, except for Alberta (18 years old) and Quebec (raised from 18 to 21 years old in January 2020)

to exposure to non-medical cannabis involved children under 12 who accidentally ingested cannabis edibles. These findings highlight the need for education for parents and children on the potential harms of edible cannabis products and the importance of proper storage, especially after the legalization of these products.

A surge in demand was expected for cannabis edibles once legally made available, given their popularity even before legalization (Lung Health Foundation, 2018: 10). For example, the 2019 Canadian Cannabis Survey found that edible food products were the second most common type of cannabis product used (44%) among people who used cannabis in the past 12 months, an increase from 41% in 2018. [9] In addition, 23% of users reported using cannabis oil for oral use and 17% used concentrates/extracts in 2019 (Government of Canada, 2019e).

4.2 Legalization of Medical Cannabis

The use of cannabis for medical purposes was legalized in Canada in 2001. Under provisions of the *2018 Cannabis Act*, users of cannabis for medical purposes will continue to have access to medical cannabis as long as they continue to meet the federal requirements for access. Specifically, medical cannabis users must be registered with Health Canada's medical cannabis program; they must be prescribed cannabis from an authorized health professional; and access to medical cannabis products remains restricted to licensed producers by mail or the use of a special license authorizing users to grow their own cannabis for personal use. Unlike the US (where qualifying medical conditions vary by state), any condition can be authorized for medical cannabis use in Canada, as long as physician authorization is received (Turna et al., 2020).

As the line between recreational and medical cannabis is becoming less distinct, with more overlap between both types of users, there have been calls to revise Canada's distribution system of medical cannabis to allow for greater access and fewer restrictions. The Government of Canada plans to undergo an extensive review of Canada's existing medical cannabis system by 2023.

4.3 Restrictions on the Promotion and Marketing of Cannabis

The *2018 Cannabis Act* also includes a number of restrictions on the promotion and marketing of cannabis and related products. [10] These restrictions were designed to protect public health and safety, particularly for the youth population, by discouraging the consumption of cannabis and protecting them from marketing and advertising designed to make cannabis products more appealing and attractive to youth (GC, 2018a; Health Canada, 2018).

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[9] https://www.canada.ca/en/health-canada/services/publications/drugs-health-products/canadian-cannabis-survey-2019-summary.html#s2

[10] See Cannabis Act (S.C. 2018, c. 16). Accessible at https://laws-lois.justice.gc.ca/eng/acts/C-24.5/index.html. See Health Canada (2018) for a summary of the legal restrictions on the promotion and marketing of cannabis.

5.0 Cannabis Statistics and Trends in Canada

5.1 Cannabis Use and Prevalence in Canada

Data on cannabis use in Canada comes from several sources, briefly outlined in Table 3.

Table 3: Key surveys on cannabis use in Canada

Survey	Research Group	Dates	Sample	Definition of Cannabis Use
Canadian Tobacco, Alcohol, and Dug Use Survey (CTADS)	Health Canada	Conducted every two years, from 2002 – 2016/17	Canadians aged 15 and older	Past 12 month use
Canadian Student Tobacco Alcohol, and Drugs Survey (CSTADS)[1]	Health Canada	Conducted every two years, from 2002 to 2018-19	Students in grades 7-12	Past 12 month use
National Cannabis Survey (NCS)	Statistics Canada	Conducted quarterly beginning in 2018	Canadians aged 15 and older	Past 3 month use
Canadian Cannabis Survey (CCS)	Health Canada	Conducted annually beginning in 2017	Canadians aged 16 and older	Past 12 month use
International Cannabis Policy Study (ICPS)	University of Waterloo	Conducted annually beginning in 2018	Adults aged 16 and older in Canada and US	Past 12 month use
[1] *Formerly called the Youth Smoking Survey (YSS)*				

Prior to the legalization of recreational cannabis in 2018, cannabis was the most used illegal drug in Canada (Health Canada, 2017). Although the prevalence of cannabis use among the general population has fluctuated slightly since 2009, there has been an overall upward trend in the consumption of cannabis in Canada. As shown by Table 4, approximately 11% of the general population self-reported using cannabis in 2009. Following the legalization of cannabis in 2018, cannabis consumption increased to approximately 17% of adults aged 15 years and older in 2019 and 20% in 2020. The population of cannabis users in 2019 consisted of both first-time users and former users who tried cannabis again (post-legalization) (StatCan, 2019). In the first quarter of 2019, an estimated 646,000 cannabis users identified as first-time users — double the corresponding estimate of 327,000 for 2018, prior to legalization (StatCan, 2019). An additional 578,000 new cannabis users were added in the second and third quarters of 2019. [11]

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[11] Data for the fourth quarter of 2019 was not available.

Table 4: Historical Incidence of Cannabis Consumption in Canada, 2009-2019

Year	Percentage (%)
2009[1]	10.6[5]
2010[1]	10.7[5]
2011[1]	9.1[5]
2012[1]	10.2[5]
2013[2]	10.6[5]
2014[2]	no data available
2015[2]	12.3[5]
2016[2]	no data available
2017[2]	14.8[4]
2018[3]	14.9[6]
2019[3]	16.8[7]
2020[3]	20.0[8]
Notes: Due to methodological differences between CADMUS, CTADS and Statistics Canada in the collection and reporting of statistics, data should be interpreted with caution. [1]Health Canada, CADUMS (2012). [2]Health Canada, CTADS (2013, 2015, 2017). [3]Statistics Canada, National Cannabis Survey (2019). [4]Based on population estimate. [5]Based on sample size. [6]Based on first three quarters of 2018 (before legislation). [7] First, second, third, and fourth quarters of 2019 combined. [8] Based on the fourth quarter of 2020 (collected Nov-Dec)	

When past-year cannabis use is used as the criterion, prevalence estimates may be higher than the estimates of past three-month use from the National Cannabis Survey (NCS). For example, the 2020 Canadian Cannabis Survey (conducted from April – June 2020) results suggest that 27% of adults used cannabis in the past year – an increase from 25% in the 2019 survey and 22% in 2018.

Data on the frequency of cannabis use suggests that daily or almost daily use in Canada is lower than the overall prevalence rates. According to the NCS results (Rotermann, 2020), the frequency of daily or almost daily use did not change in the first year after legalization (5.9% in 2018; 6.0% in 2019). Estimates from another national survey, the International Cannabis Policy Study (ICPS) [12], were slightly higher for 2018. Findings from the ICPS showed that 8.9% of respondents used cannabis daily or almost daily in 2018, and almost one-quarter (27.6%) had used cannabis in the past year [13] (Hammond et al., 2020).

Consistent data on cannabis use disorder (CUD) prevalence is lacking in Canada compared to the US; however, earlier estimates suggest that about one in five adult cannabis users in Canada reported select CUD symptoms in 2013, [14] and an overall dependence rate of 1.3% was reported in the general population of Canada in 2012 (Jutras-Aswad et al., 2019). If the rates of CUD found in

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[12] An online survey of over 10,000 adults aged 16-65 in Canada, conducted from August-October 2018.
[13] Estimates were weighted to the population and rescaled to sample size. The estimate of 23.9% represents the total among those who said they had used cannabis in the past 12 months; and those who were monthly, weekly, or daily/almost daily users. These results are not directly comparable with the 2018 estimate from the National Cannabis Survey, which used a timeframe of the last 3 months to define use.
[14] According to data from the Canadian Tobacco, Alcohol and Drugs Survey (CTADS)

the US (see Section 3.3) were applied to Canada, the projected number of adults with CUD has been estimated to range from 430,000 to 830,000 individuals, with possible increases expected following the legalization of cannabis in Canada, based on recent trends (Jutras-Aswad et al., 2019).

More research is needed to evaluate the impact of legalization on cannabis consumption and prevalence rates. In addition, patterns of cannabis consumption in 2020-21 may be impacted by the ongoing Coronavirus 2019 (COVID-19) pandemic, which has significantly altered the lives of Canadians and affected mental health and well-being. There is some evidence to suggest that cannabis consumption has increased during the pandemic, particularly among young adults. For example, a survey by the Canadian Red Cross in June 2020 found that more than one-quarter (27%) of adults reported using cannabis more frequently in the past month compared to an average month before the pandemic, while only 12% reported using it less, resulting in a net gain in consumption by 15% (Canadian Red Cross, 2020). Results from the Canadian Perspectives Survey Series conducted in July 2020 showed that 12% of young adults aged 15 to 34 reported an increase in their use of cannabis during the pandemic – a higher proportion than older adults aged 35 to 54 (5.5%) or 55 and older (1.5%) (StatCan, 2020a). An increase in cannabis sales has also been reported during the pandemic, with data from Statistics Canada showing a steady increase in monthly retail sales each month from May until September 2020 (StatCan, 2020b). [15]

5.2 Cannabis Use in Canada According to Sex

As shown by Table 5, consumption patterns according to sex reveal that males have traditionally outnumbered females with respect to their consumption of cannabis. In 2009, cannabis consumption rates were approximately 14% among males compared to 7% among females. Following the legalization of cannabis in 2018, consumption of cannabis increased to approximately 19% for males and approximately 13% for females in 2019; and increased slightly further by the end of 2020 (21% among males and 18% among females). [16] Patterns of consumption for females have steadily increased since 2011, with rates of consumption becoming comparable for males and females for the first time in 2020 (Rotermann, 2021).

Table 5: Consumption of Cannabis in Canada According to Sex, 2009-2019

Year	Gender (Percentage)	
	Male	Female
2009[1]	14.2[5]	7.2[5]
2010[1]	14.6[5]	7.1[5]
2011[1]	12.2[5]	6.2[5]
2012[1]	13.7[5]	7.0[5]
2013[2]	13.9[5]	7.4[5]
2014[2]	no data available	no data available
2015[2]	14.9[5]	9.7[5]
2016[2]	no data available	no data available
2017[2]	18.7[4]	11.1[4]
2018[3]	17.5[6]	12.3[6]
2019[3]	18.7[7]	13.4[7]
2020[3]	21.1[7,8]	18.4[7,8]

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[15] It should be noted that the increase in retail sales may be due to other factors besides the impact of the COVID-19 pandemic, including an increase in the number of stores.

[16] Results are from the National Cannabis Survey, which asked about cannabis use among Canadians aged 15 and older in the past three months.

The Canadian Cannabis Survey (CCS), conducted annually by Health Canada since 2017, provides additional information on cannabis use by sex. Results from the CCS show that cannabis use is higher among males than females but increased among both groups from 2018 to 2020 (from 26% to 31% among males; and from 18% to 23% among females) [17] (Government of Canada, 2019e; 2021).

These findings are consistent with research evidence from other countries, which has consistently shown a higher prevalence, frequency and quantity of cannabis use as well as CUD among boys and men compared to girls and women (Jutras-Aswad et al., 2018). However, studies from the U.S. show that the gender gap has been narrowing in recent years as more females experiment with cannabis use (Greaves et al., 2019). Similar gender patterns have been found for medical cannabis use (Greaves et al., 2019). Therefore, despite the overall lower number of females using cannabis compared to males, the proportion of females who use cannabis appears to be rising, highlighting the urgent need for more research on sex, gender and cannabis use to help inform strategies to address cannabis use among females, including pregnant females (see Section 9.3 on Future Research).

5.3 Cannabis Use in Canada According to Age

Consumers of cannabis tend to be young (i.e., ≤ 24 years of age). In 2018, prior to legalization, [18] the greatest share (approximately 31%) of cannabis consumers in Canada were between 18 and 24 years of age. By 2019, this increased slightly to approximately 33% for the same age category. The prevalence of cannabis use among those aged 25 and older was 13% in 2018 and 16% in 2019. According to Statistics Canada, the prevalence of cannabis use [19] remained largely unchanged from 2018 to 2020 for 18 to 24-year-olds (see Table 6). However, use appeared to decrease among the youngest age group (ages 15 to 17) after legalization – from 19.8% in 2018 to 10.4% in 2019. The age group that accounts for the second-largest share of female cannabis users (ages 25 to 44) also accounts for the largest share of women having children. [20]

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[17] Estimates of cannabis use from the Canadian Cannabis Survey are higher than the estimates from the National Cannabis Survey due to differences in the definitions and timeframes used. For example, the NCS asked about cannabis use in the past three months, while the CCS asked about use in the last 12 months.
[18] Based on data from the first three-quarters of the 2018 NCS.
[19] Defined as any use in the past 3 months prior to the survey
[20] Since 2010, the average age of mothers at childbirth has been over 30 years and is steadily increasing, reaching 30.8 years in 2016 (StatCan, 2018a). For the same year, the average age of first-time mothers was 29 years (StatCan, 2018a).

Table 6: Number and Percentage of People Reporting Cannabis Use By Year and Age Group, 2018-2020

	Before Legalization (2018)[1]		After Legalization (2019)[2]		After Legalization (2020)[3]	
	Thousands	Percentage	Thousands	Percentage	Thousands	Percentage
Canada	4457.5	14.9	5122.2	16.8	6,184.3	20.0
Age group						
18 to 24	811.2	30.9	896.7	33.3	1042.1	35.6
25 to 44	2203.2	21.2	2577.3	24.4	3232.5	30.3
45 to 64	981.6	10.0	1159.3	11.9	1711.7	10.5
65 or older	243.7	4.1	369.8	5.9		

[1] Data from the first three quarters of the 2018 National Cannabis Survey

[2] Data from all four quarters of the 2019 National Cannabis Survey

[3] Data from the fourth quarter of the 2020 National Cannabis Survey

Sources: Statistics Canada. (2019). Table 1: Prevalence of cannabis use and daily or almost daily use in the past 3 months, by before or after legalization and selected demographics, household population aged 15 or older, Canada (provinces only), 2018 and 2019. https://www150.statcan.gc.ca/n1/pub/82-003-x/2020002/article/00002/tbl/tbl01-eng.htm

Statistics Canada (2021). Table 1: Prevalence of cannabis use in the past three months, by time relative to legalization and quarter, and selected demographics, household population aged 15 and older, Canada (provinces only), first quarters of 2018 and 2019, and fourth quarter of 2020. https://www150.statcan.gc.ca/n1/pub/82-003-x/2021004/article/00001/tbl/tbl01-eng.htm

5.4 Use of Medical Cannabis in Canada

The use of cannabis for medical purposes has also steadily increased in Canada. In October 2018, there were 345,520 active client registrations with a federal license for medical cannabis. By October 2019, one year after legalization, the number of licenses had increased to 363,555. (GC, 2019c). However, the number of licenses decreased again by the start of 2021, with 292,399 licenses as of March 2021.

Despite the growth in medical cannabis use, the proportion of cannabis users who use it for medical purposes is much lower than the proportion of non-medical cannabis users. Results from the 2019 Canadian Cannabis Survey showed that only 14% of all respondents aged 26 years and older reported using cannabis for medical purposes (vs. 13% in 2018), compared to 86% who reported non-medical cannabis use. However, the majority of those who used cannabis for medical purposes in the 2019 survey (73%) did not have a document from a healthcare professional (GC, 2019e). These findings are consistent with other Canadian data showing the low proportion of medical cannabis users compared to recreational users, and of medical users who have legal authorization. For example, in a 2018 study of cannabis users [21] in Canada, the majority (61%) reported exclusive recreational use, and less than one-quarter (23%) of medical users reported having authorization from a health professional (Turna et al., 2020). In addition, among those who used cannabis for

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[21] Data were from 709 adult participants out of 1502 who reported cannabis use in the past six months in the Population Assessment for Tomorrow's Health Research Registry study.

medical use, most also reported using it recreationally; exclusive medical use (19%) was less common (Turna et al., 2020).

Although medicinal cannabis use has been endorsed for a variety of medical concerns and conditions, data from medical cannabis users in Canada on specific reasons for use is limited. Studies from the US have shown that the most common reason for medical cannabis use among adult patients is for management of chronic pain (Park & Wu, 2017). According to 2018 data from Canada (see Figure 2), the majority of patients with medical marijuana prescriptions were prescribed for unspecified conditions (i.e. "other"). Among female users, other reported reasons for having a medical marijuana prescription included post-traumatic stress disorder (PTSD) (approximately 8%); chronic pain (6%); anxiety (5%); fibromyalgia (4%); depression (3%); major depressive disorder (MDD)(2%); disc disease and back pain (approximately 2%, respectively); and insomnia (1%).

Figure 2: Top conditions which qualified for medical marijuana prescriptions in Canada as of 2018, by sex
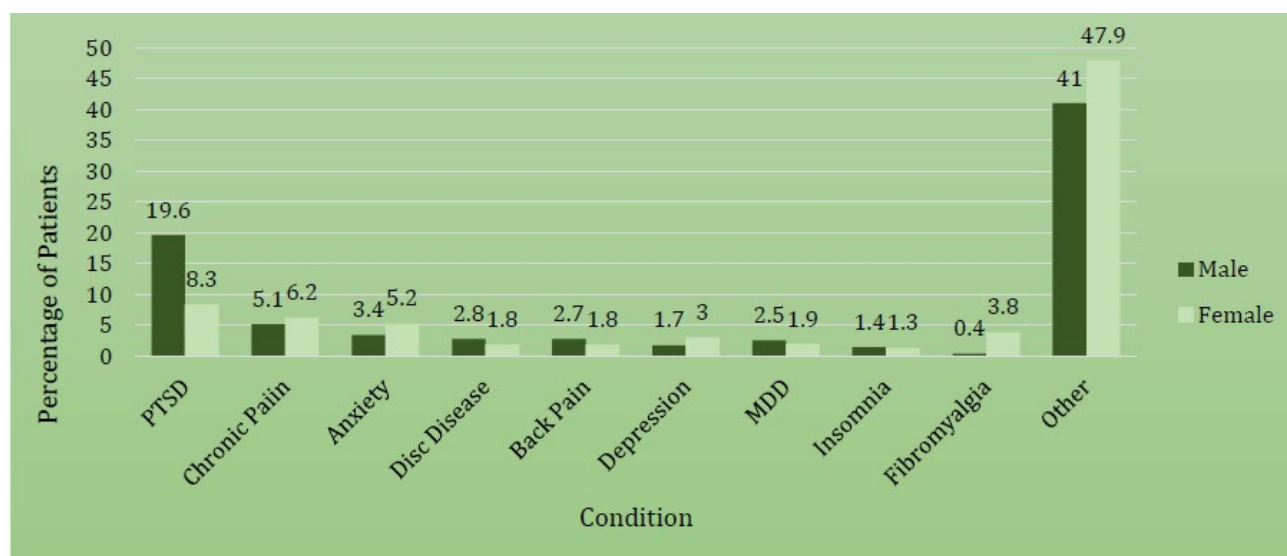
Note: based on a sample of 6,427 respondents.
Source: New Frontier Data. (2018). Top Conditions Which Qualified for Medical Marijuana Prescriptions in Canada as of 2018, By Gender. In *Statista—The Statistics Portal*. Original source: the Canada Cannabis Report: 2018 Industry Outlook, p. 38. Retrieved from <https://www.statista.com/statistics/887929/top-reasons-for-medical-marijuana-prescriptions-canada-by-gender/>

6.0 Cannabis Use by Pregnant Women

6.1 Prevalence of Use During Pregnancy

Evidence from Canada:

Similarly to women in the general population, pregnant women are increasingly using cannabis. In what is considered to be one of the first extensive studies examining the prevalence of cannabis use by females during pregnancy in Ontario from 2012 to 2017, Corsi et al. (2019a: 76) found that the percentage of pregnant women self-reporting that they used cannabis at any point during their pregnancy steadily increased from 1.2% in 2012 to 1.8% in 2017, equivalent to a relative increase

of 61% (see Table 7). The study's co-author, Dr. Daniel Corsi, suggested that the findings could be generalized to other provinces, although the study was conducted in Ontario.

Table 7: Cannabis Use During Pregnancy, Ontario, Canada, 2012-2017

Year	All Singleton Live Births and Still Births		Cannabis Use During Pregnancy	
	Sample Size	Percent (%)	Sample Size	Percent (%)
All Women	732,818	100	10,731	100
2012-2013	122,519	16.7	1,527	1.24
2013-2014	125,890	17.2	1,604	1.27
2014-2015	127,355	17.4	1,790	1.41
2015-2016	127,268	17.4	1,892	1.49
2016-2017	129,929	17.7	2,175	1.67
2017	99,857	13.6	1,743	1.75
Source: Corsi, D. J., Hsu, H., Weiss, D., Fell, D.B. and Walker, M. (2019). "Trends and Correlates of Cannabis Use in Pregnancy: A Population-Based Study in Ontario, Canada from 2012 to 2017," *Canadian Journal of Public Health*, 110: 79.				

More recently, two surveys have provided national estimates in Canada of the prevalence of cannabis use during pregnancy and while breastfeeding. The national Survey on Maternal Health - a study of over 7,000 women in Canada who gave birth between January-June 2018 - estimated the prevalence of opioid and cannabis use during pregnancy. Findings revealed that 3.1% of women reported using cannabis during pregnancy, and 2.6% reported using cannabis while breastfeeding (Grywacheski et al., 2020). Results from the Canadian Cannabis Survey [22] showed that among women aged 16-50 who had given birth in the last five years, the majority reported that they did not use cannabis during their last pregnancy, with no change between 2018 and 2020 (96% in 2018; 93% in 2019; 96% in 2020). The percentage who reported they did not use cannabis while breastfeeding their last child also remained high (96% in 2018; 92% in 2019; 94% in 2020). [23]

While studies on the use of cannabis during pregnancy after its legalization in Canada in 2018 are limited, initial evidence from one survey of pregnant individuals attending prenatal clinics in

Hamilton, Ontario conducted from May to October 2019 suggests an increase in consumption among this population (Kaarid et al., 2021). For example, results showed that 11% of participants had consumed cannabis at some point in their pregnancy; 4% were currently consuming cannabis; and 5% of those planning to breastfeed intended on consuming cannabis during that time. These estimates are higher than those found prior to legalization, which may be attributed to data collection through an anonymous survey rather than self-reporting (Kaarid et al., 2021).

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[22] Results are among women aged 16-44 in 2018; and 16-50 in 2019-20. Estimates are reported for the outcome of 'did not use cannabis' because the estimates of 'used cannabis' in each survey year had moderate to high sampling variability due to small sample sizes and were noted to be interpreted with caution or suppressed.

[23] Results are from the detailed results tables from the surveys, published on the Library and Archives website.

Evidence from the United States:

Similar patterns of cannabis consumption among pregnant women have been found in the United States, despite limited and conflicting evidence regarding its safety (Bayrampour, et al., 2019; Mark et al., 2017a; Grant, 2016b). Using data from the U.S. National Survey on Drug Use and Health (NSDUH), Brown et al. (2017) found that between 2002 and 2014, cannabis use among the pregnant population increased from 2.37% in 2002 to 3.85% in 2014, for an overall increase of 62%. Although cannabis use among pregnant women decreased slightly in 2015 to approximately 3.4%, by 2017, the rate increased to 7.1%, representing an overall increase of 3.7% between 2015 and 2017 (U.S. Department of Health and Human Services, 2017). Similarly, data from a large sample of women in California showed an increase in self-reported cannabis use both before and during pregnancy from 2009 to 2017 (Young-Wolff et al., 2019). The prevalence of cannabis use in the year before pregnancy increased from 6.8% in 2009 to 12.5% in 2017, and the prevalence of cannabis use during pregnancy increased from 1.95% to 3.38%.

Prevalence of cannabis use disorder:

Most studies on cannabis use during pregnancy have not considered CUD. While there is a lack of data on the prevalence of CUD in Canada, some evidence from the US has shown a growth in CUD prevalence among pregnant women. For example, an examination of hospital discharge records across a sample of US hospitals showed a five-fold increase in the rate of CUD diagnoses among pregnancy-related hospitalizations from 1993 to 2014, rising from 1.8 to 9.4 per 1000 deliveries (Shi & Zhong, 2018). More recently, the proportion of prenatal hospitalizations involving CUD across 35 US states was found to increase substantially from 2010 to 2018 (from 0.008 of all to 0.02 of all prenatal hospitalizations) (Meinhofer et al., 2022). Moreover, five of the seven states with the highest CUD prevalence were states that had legalized recreational cannabis, which suggests that cannabis legalization policies may play a role in the increased use of cannabis during pregnancy. Evidence from the US also suggests that the prevalence of CUD may be higher among pregnant women compared to nonpregnant women – an examination of combined data from the 2007-2012 National Surveys on Drug Use and Health found that among women of reproductive age who used cannabis in the past year, the prevalence of CUD [24] differed between pregnant and nonpregnant women (18.1% vs. 11.4%, respectively) (Ko et al., 2015).

6.2 Growing Perception that Cannabis is Safe

Perceptions of harm among the general population:

Research on harm perceptions of cannabis use, in general, shows that most youth in Canada are aware of the health risks of using cannabis regularly (Leos-Toro et al., 2020). However, many people, including young people, still perceive cannabis to be a natural product that is not addictive and does not have long-term health effects. For example, in a 2016 survey of Canadians, only 58% of respondents perceived marijuana to be addictive, and the majority believed it to be either: more helpful than harmful to physical health; have no impact; or were unsure if it caused physical harm (Spackman et al., 2017). The literature on other types of substance use, such as tobacco, shows that greater awareness of the health risks is associated with a lower likelihood of use; however, there is a lack of research on the relationship between perceived risk and cannabis use (Leos-Toro et al., 2020).

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[24] CUD in this study was assessed as meeting the criteria for both cannabis abuse and dependence, according to the DSM-4 criteria.

Data from the 2019 Canada Cannabis Survey suggests that the majority of Canadians are aware of the harms of cannabis use during pregnancy and breastfeeding; however, cannabis users were less likely than non-users to believe that use during pregnancy or breastfeeding is harmful (82% vs. 89%) (GC, 2019e). Data from the 2020 survey [25] showed a similar trend, whereby 88% of respondents overall did not agree that it is okay to use cannabis when pregnant or breastfeeding, but non-users were more likely to disagree (90%, vs. 83% of cannabis users).

Perceptions of harm among the pregnant population:

Among pregnant women, increasing use of cannabis has been accompanied by the perception that cannabis use is safe with little or no associated risks during pregnancy (Bayrampour et al., 2019; Holland, et al., 2016; Ko et al., 2015; Young-Wolff et al., 2019). According to data from the US National Survey on Drug Use and Health, the perception that regular cannabis use poses no risk increased three-fold from 2005 to 2015 among both pregnant and non-pregnant women (Jarlenski et al., 2017). Another study examining data from the same survey from 2007-2012 revealed that about 70% of pregnant women who used cannabis in the past year believed there was little or no risk of harm from smoking it once or twice a week (Ko et al., 2015). Bayrampour et al. (2019) suggest several factors that may help to explain the continued use of cannabis during pregnancy, including: the lack of clarity regarding the adverse perinatal consequences of cannabis and uncertainty about the specific harms it can cause; its perceived therapeutic effects; and lower costs of cannabis compared to that of cigarettes. This uncertainty has also been noted in qualitative research conducted among pregnant patients, which showed that many women held conflicting perceptions about the safety of cannabis use during pregnancy - even within the same individuals, highlighting the complexity in harm perceptions (Chang et al., 2019). For example, women in the study described cannabis as "natural" and safe and preferable to prescribed medications, but also expressed concerns and uncertainty about the potential risks and addictiveness (Chang et al., 2019). In contrast, research has also identified some factors that can help motivate cannabis users to quit during pregnancy, including: the belief that it can harm the pregnancy or cause long-term harm to the fetus; saving money; and wanting to set a good example as a parent (Bayrampour et al., 2019).

The lack of adequate communication from health care professionals regarding the health implications of cannabis has also been found to have a significant influence on pregnant women's perceptions of risk (Jarlenski et al., 2016). For instance, Bayrampour et al. (2019) note that "[w]omen perceived [the] lack of counseling as an indication that adverse outcomes associated with cannabis use [were] not significant" (p. 22).

Given the level of uncertainty in the literature on the effects of cannabis use, increased communication by health care providers regarding the safety and associated risks of cannabis consumption is of utmost importance (Bayrampour et al., 2019; Chang et al., 2019) (see Section 9.4 on Policy Implications for further discussion). Without this communication from health providers, women may turn to less reliable sources, such as cannabis retailers or social media, friends, and family, through which they often receive incomplete information about cannabis use during pregnancy (Young-Wolff et al., 2019; Barbosa-Leiker et al., 2020).

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[25] The measure of perceived harm changed slightly in the 2020 Canadian Cannabis Survey (which asked whether participants agree that it is okay to use cannabis while pregnant or breastfeeding) compared to the 2019 survey (which asked whether cannabis use during pregnancy or breastfeeding can be harmful).

6.3 Demographics of Pregnant Women Using Cannabis

Studies have shown that women who use cannabis during pregnancy tend to be younger and of lower socio-economic status and education level (Kaarid et al., 2021; Grywacheski et al., 2020; Brown et al., 2019; Young-Wolff et al., 2019; Corsi et al., 2019a; Luke et al., 2019; Mark et al., 2017a; Ko et al,, 2015; Oh et al., 2017). Researchers have also found that women who use cannabis while pregnant reported poorer mental health, including depression and anxiety (Mark et al., 2017a; Oh et al., 2017; Brown et al., 2019; Grywacheski et al., 2020). Additionally, women who use cannabis while pregnant are more likely to be unmarried (Oh et al., 2017). Among pregnant women who identified as being in a relationship, one cross-sectional study from Ontario found that having a partner who uses cannabis increases the likelihood of cannabis consumption while pregnant or intent to consume while breastfeeding, compared to having a partner who does not consume cannabis (Kaarid et al., 2021). In terms of regional differences, data from the national Survey on Maternal Health found that women in British Columbia were more likely to use cannabis while pregnant and breastfeeding compared to women in Ontario, with no other differences between provinces (Grywacheski et al., 2020).

Other factors associated with cannabis use while breastfeeding among Canadian women include lower education levels, thoughts of self-harm, and self-reported anxiety and depression symptoms (Grywacheski et al., 2020).

In their analysis of cannabis consumption among pregnant women, shown in Table 8, Corsi et al. (2019a) found that over half (52%) were in the youngest age category of 15-24 years old and were from urban centres with greater than 100,000 inhabitants (53%).

Table 8: Demographics of Women Using Cannabis During Pregnancy, Ontario, 2012-2017

	All Singleton Live Births and Still Births		Cannabis Use During Pregnancy	
	Sample Size	**Percent (%)**	**Sample size**	**Percent (%)**
All Women	732,818	100	10,731	100
Maternal Age at Delivery				
15-24	98,437	13.4	5,580	52.0
25-29	203,358	27.8	2,822	26.3
30-34	266,367	36.5	1,622	15.1
35 and older	164,656	22.5	707	6.6
Income Levels				
Lowest	111,222	15.2	3,460	32.2
Medium Low	113,894	15.5	2,414	22.5
Middle	152,153	20.8	2,121	19.8
Middle-High	173,540	23.7	1,667	15.3
Highest	182,009	24.8	1,069	10.0
Population Size				
Rural Area	97,897	13.4	1,829	17.0
1,000-29,999	66,971	9.1	1,510	14.1
30,000-99,000	57,542	7.9	1,730	16.1
100,000 +	510,408	69.7	5,662	52.8
Source: Corsi, D. J., Hsu, H., Weiss, D., Fell, D.B. and Walker, M. (2019). "Trends and Correlates of Cannabis Use in Pregnancy: A Population-Based Study in Ontario, Canada from 2012 to 2017," *Canadian Journal of Public Health*, 110: 79.				

6.4 Patterns and Reasons for Cannabis Consumption During Pregnancy

Reasons for cannabis use during pregnancy are often therapeutic reasons, including: to manage mood or stress; to improve sleep; as a natural substitute for other medications to treat pregnancy-related symptoms; and to treat morning sickness and nausea, allowing them to eat more to provide nourishment to the fetus (Young-Wolff et al., 2019; Bayrampour et al., 2019; Barbosa-Leiker et al., 2020; Kaarid et al., 2021).

Rates of cannabis consumption tend to decline throughout pregnancy, with the highest rates during the first trimester and lowest during the third trimester (Bayrampour et al., 2019; Ko et al., 2015; Singh et al., 2019). The most common reason for using cannabis early in the pregnancy is to treat nausea (Bayrampour et al., 2019; GC; Ontario Agency for Health Protection and Promotion, 2018; Mark et al., 2017a; Roberson et al., 2014; Westfall et al., 2009). Despite clinical recommendations against the use of cannabis for the treatment of nausea (GC, 2018g; Volkow et al., 2017), Westfall et al. (2009) found that an estimated 77% of medicinal cannabis used during pregnancy was done so to control nausea.

In a study examining advice about cannabis use during pregnancy given by a selection of 400 dispensaries in Colorado, the majority of dispensaries (69%) recommended cannabis products to treat morning sickness in the first trimester and 36% endorsed the safety of cannabis during pregnancy. While the majority of dispensaries (81%) also recommended consulting a health care provider about using cannabis during pregnancy, most did so only after being prompted with a question by the patient about whether they should talk to their doctor; only 32% recommended discussion with a health care provider without prompting (Dickson et al., 2018).

7.0 Policy Positions of Key Canadian, American and International Health Bodies

A strong consensus exists among key Canadian, [26] American, [27] and international, [28] health bodies that there is a need for increased counseling and education of pregnant women by healthcare professionals to abstain or reduce cannabis use while pregnant (Ontario Agency for Health Protection and Promotion, 2018; Health Canada, 2019; Allan et. al, 2018; Porath et al., 2018; Canadian Association of Midwives, 2018; American College of Obstetricians and Gynecologists, 2017; Foeller & Deirdre, 2017; American Society of Addiction Medicine, 2015; Ryan et al., 2018; Reece-Stremtan et al., 2015; WHO, 2014; Society of Obstetricians and Gynaecologists of Canada, n.d). Appendix B provides a brief overview of the latest policy positions and/or recommendations of key Canadian, American and international health bodies regarding the use of cannabis during pregnancy.

Recognizing the need for a public health approach to reducing the harms of cannabis use at the population level, the Lower-Risk Cannabis Use Guidelines (LRCUGs) have also been developed for the Canadian context. The guidelines, originally developed in 2011 and revised in 2017 prior to legalization in Canada, provide evidence-based recommendations for cannabis use based on

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[26] Canadian Centre on Substance Use and Addiction, College of Family Physicians of Canada, Society of Obstetricians and Gynaecologists of Canada, Canadian Association of Midwives and Health Canada
[27] American Academy of Pediatrics, Academy of Breastfeeding Medicine, American Society of Addiction Medicine and American College of Obstetricians and Gynecologists
[28] World Health Organization [WHO]

research identifying behaviours that increase the risk of problematic use. The LRCUGs also provide a template for monitoring and evaluating the impact of cannabis policies. In developing the guidelines, the researchers assessed the level of evidence demonstrating the adverse impacts of cannabis use during pregnancy. They determined that there is substantial evidence that some populations, including pregnant women and those with a predisposition or family history of psychosis and substance abuse, are at probable higher risk for cannabis-related adverse effects and recommended that these groups refrain from using cannabis (Fischer et al., 2017). The complete set of ten recommendations are summarized in Table 9 below. Evidence from a 2018 study in Canada and the US found varying levels of adherence to these recommendations. The majority of cannabis users [29] in Canada (88%) had engaged in at least one of the risky behaviours identified in the LRCUGs, and 18% were identified as high-risk users, including pregnant women. [30]

Table 9: Lower-Risk Cannabis Use Guidelines and Associated Evidence Grades

Recommendation	Level of Evidence
Abstain from cannabis use if possible (general precautionary principle)	N/A
If you use cannabis, start later in life (particularly avoid use prior to age 16 years)	Substantial
Choose lower-strength products, such as those with a lower THC content or a higher ratio of CBD to THC	Substantial
Do not use synthetic cannabis products	Limited
Avoid smoking cannabis (choose other modes of use such as vaping or edibles)	Substantial
Avoid deep inhalation when smoking cannabis	Limited
Try to limit your use as much as possible (avoid daily/near-daily use)	Substantial
Don't drive or operate machinery after using cannabis	Substantial
Avoid cannabis use if you are pregnant or have a personal predisposition toward or first-degree family history of psychosis or substance use disorders	Substantial
Avoid combining the risky behaviors listed above	Limited
Source: Goodman et al. (2020); Fischer et al. (2017)	

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[29] Defined as those who had used cannabis in the past 12 months
[30] However, the study did not distinguish between the number of cannabis users who were pregnant women in this category versus other high-risk groups.

8.0 Empirical Research Findings: Health Effects of Maternal Cannabis Consumption

8.1 Overview of How Cannabis Affects the Fetus/Infant

Like tobacco and alcohol, the use of cannabis during pregnancy can affect the fetus and/or newborn child. Studies have found that THC crosses the placenta rapidly (Ontario Agency for Health Protection and Promotion, 2018; Grant, 2016a, 1; Hutchings et al., 2015; Miller and Fico, 1989). This is important because the placenta plays a vital role in providing nutrients and oxygen to the fetus through the mother's bloodstream (Grant, 2016a: 1; Behnke and Smith, 2013). Indeed, evidence suggests that cannabis use during pregnancy increases placental vascular resistance, thereby reducing the flow of oxygen through the placenta and delaying the growth of the fetus (Brar et al., 2019). Evidence has also shown that cannabis use during pregnancy is associated with an increased risk of cesarean delivery and neonatal oxygen supplementation at birth (Sasso et al., 2021).

The chemical substances in cannabis are also transmitted through the mother's blood to the fetus during pregnancy and passed into the breast milk following birth (Government of Canada, 2018g; Syme et al., 2004). Studies (Fried, 2011; Lee, 1998) have found THC concentrations in the fetus to be approximately one-third of the levels found in the mothers (Grant, 2016a). Cannabis can remain in the mother's body and be detected in her urine for an extended period of time, usually for weeks (Behnke and Smith, 2013; Grant, 2016a, 1); however, this can vary depending upon factors such as the potency of the cannabis strain; frequency of use, and mother's metabolism (Grant, 2016a). THC has also been found in breastmilk up to six days after use; however, less is known about the presence and effects of CBD in breastmilk (Bertrand et al., 2018; US FDA, 2019). Overall, the available evidence on the isolated effects of cannabis consumption while breastfeeding is still unclear, partly due to the confounding effects of in utero exposure (Kaarid et al., 2021).

8.2 Summary of Evidence From the Literature on Health Effects of Prenatal Cannabis Use

Effects on the fetus:

As shown in the literature synthesis conducted for this review (see Appendix C for references and details of each study), studies on the health effects of maternal cannabis use have found several potential adverse effects on the fetus, including lower birth weights, small for gestational age, fetal growth restriction, congenital anomalies, stillbirths, pre-term births, transfer to neonatal intensive care; death within one year of birth, and altered brain development. However, the strength of the overall evidence on the health effects for the fetus is limited by mixed findings across studies. According to the review by NASEM conducted in 2017 on the health effects of prenatal, perinatal, and neonatal exposure to cannabis, there was only sufficient evidence for an association between maternal cannabis smoking and low birth weight in the offspring; the effects on other outcomes

(e.g., pregnancy complications, admission to neonatal intensive care, and later childhood outcomes) was still insufficient or unclear (NASEM, 2017).

Additional findings from empirical research on the health effects of maternal cannabis use on the fetus include the following:

- There is limited information in the literature on frequency of cannabis use (Singh et al., 2019); however, some evidence indicates that greater frequency or prolonged use of cannabis during pregnancy may further increase these health risks (e.g. Grzeskowiak et al., 2020).
- In addition, one study (Grzeskowiak et al., 2020) found no difference in outcomes for infants of mothers who stopped using cannabis by 15 weeks of pregnancy compared to mothers who never used cannabis, suggesting the need for early intervention to prevent or reduce cannabis consumption among pregnant women.
- While there is also limited evidence on the health effects of cannabis use disorder among pregnant women, some evidence has demonstrated that prenatal CUD is associated with major adverse neonatal outcomes, including greater risk of small for gestational age, low birth weight, preterm birth and death within one year after birth (Shi et al., 2021).

Effects on the mother:

Fewer studies have examined the effects of cannabis use during pregnancy on maternal health compared to infant health; however, a recent review of the evidence found no association between prenatal recreational cannabis use and maternal outcomes such as gestational diabetes and pre-eclampsia (Singh et al., 2019). Similarly, while CUD has been associated with negative outcomes for both mother and fetus, one recent study of delivery hospitalizations in the US found that after adjusting for demographics and clinical comorbidities, CUD among pregnant women was not associated with increased risk of maternal morbidity (Jarlenski et al., 2020).

Effects of combined cannabis use with other substances:

While the use of other substances (i.e. tobacco, alcohol) during pregnancy can increase risks further, evidence on the effects of prenatal cannabis use in relation to other substances is still unclear, due to the difficulties in isolating the effects from multiple substances (see Section 9.2 on Limitations of Current Research for further discussion). For instance, in some studies, the effects of cannabis use during pregnancy have been shown to be independent of the risks of smoking tobacco (Grzeskowiak et al., 2020; Brar et al., 2019; Shi et al., 2021). However, a recent meta-analysis found that prenatal cannabis use was not an independent risk factor for adverse neonatal outcomes [31] after controlling for confounding factors such as tobacco use (Conner et al., 2016).

Long-term effects:

Long-term studies of the effects of cannabis use during pregnancy on children's health, development and well-being are limited; however, some research suggests that cannabis exposure during pregnancy may have lasting impacts on the child through childhood, adolescence, and even adulthood (Society of Obstetricians & Gynaecologists of Canada, 2021; Best Start Resource Centre, 2017). Some of these adverse effects include learning and behavioural issues (such as impulsivity and attention difficulties), an increased risk of substance misuse and/or substance use disorders, psychotic experiences, anxiety and a higher risk of neurodevelopmental disabilities, for example,

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[31] Primary outcomes were low birth weight (less than 2,500 g) and preterm delivery at less than 37 weeks of gestation.

autism and ADHD (Murnan et al., 2021; Rompala et al., 2021; Bolhuis et al., 2018; De Genna et al., 2018a; Corsi et al., 2020). Other findings from the literature on long-term effects include the following:

- Findings suggest that behavioural problems associated with prenatal cannabis exposure may manifest by age 3.5 years (Murnan et al., 2021).

- A recent study of the potential long-term effects of prenatal exposure to THC on postnatal cardiovascular health showed impaired cardiac function in THC-exposed offspring (Lee et al., 2021). While this study was conducted in a sample of rats rather than humans, the authors suggest that these negative effects could persist throughout the lifespan and contribute to poorer cardiovascular outcomes, demonstrating the importance of conducting more research to understand the long-term health effects of prenatal cannabis exposure.

- A study on the association between prenatal maternal cannabis use disorders and future road traffic injuries among offspring determined that prenatal maternal cannabis use disorders were associated with 5.64 times the risk of hospitalization for future childhood injuries from motor vehicle crashes; while prenatal cocaine, opioid, and other drug use disorders were not associated with pediatric transport-related injuries (Kang-Auger et al., 2021).

Effects of secondhand smoke:

Finally, there is a lack of evidence on the potential harms of maternal exposure to secondhand cannabis smoke or vapour during pregnancy or lactation. Some evidence shows that marijuana smoke contains THC as well as several other toxins that may pose a significant health risk and that bystanders exposed to marijuana smoke can have detectable amounts of THC in their blood and urine (American Nonsmokers' Rights Foundation; 2021; Hermann et al., 2015; Cone et al., 2015). Furthermore, given the known harms of exposure to secondhand tobacco smoke for pregnant women and that cannabis smoke contains many of the same harmful chemicals as tobacco smoke, the impacts of secondhand cannabis smoke on pregnant women and their fetus and child remain a significant cause for concern. While data on the prevalence of secondhand cannabis smoke exposure among pregnant women is not known, data from the 2020 Canadian Cannabis Survey suggests that overall exposure among the population is common, with over one-third of all respondents (36%) reporting exposure in public places in the last 30 days and 19% in the home (GC, 2021).

9.0 Conclusions and Policy Implications

9.1 Summary of Findings

The current state of scientific evidence regarding cannabis use during pregnancy can be best summarized by Dr. Therese M. Grant, Director of the Fetal Alcohol and Drug Unit at the University of Washington Medical Center: "the science is incomplete, but the public health message is clear: [t]o have the healthiest baby possible, avoid using marijuana, alcohol, and tobacco during your pregnancy" (Grant, 2016a). While research on the effects of cannabis exposure during pregnancy on the fetus and child is growing, the existing evidence remains both limited and inconsistent. Despite the lack of complete knowledge on the short- and long-term effects of cannabis use, what is certain is that for optimal health—for mothers as well as the fetus and the child in the long run—it is best for the mother to abstain from using cannabis during pregnancy (Ontario Agency for Health Protection and Promotion, 2018; Cook & Blake, 2018; Harding & Poole, 2018; Jansson et al., 2018; Grant, 2016). This guidance is consistent with the clinical guidelines and policy recommendations of key Canadian, American and international health bodies regarding the consumption of cannabis during pregnancy (Ontario Agency for Health Protection and Promotion, 2018). As found throughout the literature, no evidence proves there is a "safe" quantity of cannabis that can be consumed without affecting the health and well-being of the fetus and child; and the potential adverse consequences on offspring likely outweigh any potential therapeutic benefits to the mother (Shi et al., 2021).

9.2 Limitations of Current Research

As noted throughout this report, there are several limitations and gaps within the existing literature on cannabis and pregnancy. Greaves et al. (2019) noted that there is a paucity of cannabis research focused on issues related to sex and gender, such as sex-specific health effects (including reproductive effects) and the influence of gender roles and norms on patterns of cannabis use. As the following section describes, current human research is also limited by: (1) methodological and design limitations of cannabis studies; (2) the influence of confounding factors; (3) the lack of attention to emerging alternative forms of cannabis and methods of consumption; (4) inadequate assessments of exposure to different strains and potency levels of cannabis; and (5) reliance on cannabis users to self-report their consumption patterns.

General methodological and study design limitations:

The majority of studies on cannabis use are correlational or cross-sectional; therefore, it is not yet possible to determine the causal effects of cannabis use or to determine an accurate dose-response relationship between cannabis exposure and pregnancy outcomes. As noted by Singh et al. (2019), despite the growing number of jurisdictions (including Canada and several US states) that have legalized cannabis for recreational use, there is a knowledge gap in the literature on the impact of cannabis legalization for pregnant women, due to the lack of longitudinal studies examining cannabis use in pregnancy before and after legalization. In addition, many studies have been conducted with specific subgroups or samples and may not be generalizable to the broader population. Finally, existing research, including data from national surveys, often lacks detailed information on cannabis consumption, such as the purpose or frequency of use, timing of exposure (i.e. which trimester), and quantity, method, and type of cannabis consumed (Greaves et al., 2019; Corsi, 2019).

Influence of confounding variables—socio-economic variables and polysubstance abuse:

Studies that fail to control for confounding variables such as socio-economic variables, maternal age and polysubstance use/misuse jeopardize the validity of their findings. For example, socio-economic variables and maternal age can profoundly affect an individual's decision to consume cannabis, the frequency of their consumption, intensity and ultimately, outcomes. Failing to control for these variables may not provide an accurate representation of the effects of cannabis. Not controlling for the simultaneous use of cannabis with other drugs or substances such as tobacco or alcohol can have similar consequences. Most studies examining the effects of cannabis consumption during pregnancy involve participants who also use other drugs and substances, making it difficult to isolate the effects of cannabis (NASEM, 2017). Research has shown that pregnant women who use cannabis are more likely to use tobacco, alcohol, or other drugs that may be harmful to a child's development (Ko et al., 2015; Grant, 2016a). Similarly, women who smoke tobacco, consume alcohol and other drugs are two to three times more likely to also use cannabis (Ko, Farr, Tong, Creanga and Callaghan, 2015; Grant, 2016a). In either case, although difficult, it is essential to isolate these risk factors to arrive at accurate assessments of their independent effects.

Lack of attention to emerging alternative forms of cannabis and methods of consumption:

As noted by Corsi (2019), routes of cannabis consumption have varied greatly in recent years, with increasing availability of products such as vaporizers, tinctures, and consumables. However, most existing studies examine the effects of cannabis administered by the most widely used method (e.g. smoking) and form (e.g. dried plant) of cannabis and not exposure through alternative methods and types of cannabis, which are growing in popularity, including the following:

- Edibles and other associated cannabis products, which became legal in October 2019 and were available beginning in December 2019, are very popular among consumers and are expected to show continued growth in demand. However, as discussed earlier in the review, there are serious safety issues concerning their consumption because of the delayed onset of the drug's effect, which may cause users to overdose.
- Public interest in cannabidiol (CBD) has also increased significantly in recent years as consumers seek out alternative forms of cannabis without the intoxicating effects of THC, and is expected to continue to grow following legalization; yet little is known about the safety and efficacy of CBD products, particularly over-the-counter or low-dose preparations (Chesney et al., 2020; Sarrafour et al., 2020). This includes a lack of information about the effects of isolated CBD for pregnant women, who may be more likely to use CBD products due to their perceived lower risk of harm and medical or therapeutic benefits.
- Synthetic cannabis, which is classified as a drug in Canada and is therefore illegal under Canada's *Controlled Drugs and Substances Act*, is designed to mimic the effects of THC but is much more toxic than natural cannabis (CCSA, 2014). Although consumption of synthetic cannabis is not as prevalent in Canada as it is in the United States, Health Canada has advised Canadians against the purchase and consumption of synthetic cannabis because of the possible adverse effects associated with inhaling or ingesting synthetic cannabis, including vomiting, chest pain, increased heart rate, vision blackouts, headaches, kidney damage, agitation, high blood pressure, and psychosis (GC, 2017). There is very little research on the use and effects of synthetic cannabis in Canada (CCSA, 2014).

Inadequate assessments of exposure to different strains and potency levels of cannabis:

Another limitation of studies examining the effects of cannabis on pregnancy is inadequate assessments of exposure to different strains and potency levels of cannabis. Potency is a significant issue because THC content has significantly increased over the years and is often underestimated, leading to increased risks of harm (El Sohly et al., 2016). The US National Institute on Drug Abuse (NIDA, n.d.) estimated that in the early 1990s, the average THC count in cannabis was approximately 4%. By 2013, this reached 10%, and for some products such as cannabis extracts, the THC can exceed over 80%. More recently, results from potency monitoring programs in the US and Europe have continued to show a dramatic increase in the average THC concentration of cannabis products, with an increase from 8.9% in 2008 to 17.1% in 2017 found in the US (Chandra et al., 2019). Higher potency can increase the risk of an adverse reaction, particularly for new users or younger demographics whose brains are still developing (NIDA, n.d.). The trend of increasing THC concentrations is also concerning for pregnant women, as they may continue to use cannabis in the first trimester of pregnancy, before they are aware of being pregnant (Singh et al., 2021). According to the US NIDA (n.d.), existing research does not fully account for the consequences of exposure to high THC levels on the body and brain and the extent to which cannabis users adjust for increased potency.

Reliance on self-report measures:

Current research is also limited by an overabundant reliance on self-report measures to track cannabis use (Cuellar, 2018; Greaves et al., 2019). Recognized as the most widely used form of substance use assessment, self-report measures offer researchers several advantages: they are easy to administer, cost-effective and non-invasive, particularly when large samples are involved; they can be conducted simultaneously in different locations; responses are quantifiable and easily analyzed; and they can be designed to capture a variety of issues of interest to the researcher (Ritchter and Johnson, 2001: 809). However, despite their advantages, self-report measures are subject to issues of validity and reliability, which can compromise data and research findings (Ritchter and Johnson, 2001: 809; Young-Wolff et al., 2020). For example, the accuracy of self-reported data can be hindered by poor recall or social desirability bias, whereby cannabis users may not fully disclose their consumption patterns to avoid judgement – particularly for sensitive topics such as cannabis and pregnancy or breastfeeding (Greaves et al., 2019). As a result, researchers may not be able to gauge their consumption adequately, and prevalence rates may be underestimated (Cuellar, 2018; Prince et al., 2018; Young-Wolff et al., 2020; Corsi, 2019). Whether cannabis users will be more open to revealing the extent of their cannabis consumption post-legalization remains unclear. Until there is full disclosure, it is essential to be aware of the limitations of self-report measures used in existing research.

9.3 Future Research

To overcome the limitations of current research and provide a clearer understanding of the health effects of cannabis consumption during pregnancy, it is recommended that researchers design future research plans that: include sex and gender-based analyses; control for the influence of confounding factors; explore alternative forms of cannabis consumption and the growing popularity of alternative types of cannabis; take into consideration the effects of different strains, potency, and types of exposure of cannabis; explore alternative methods of tracking cannabis consumption; increase longitudinal studies in cannabis research; and explore the emergence and treatment of cannabis-related disabling disorders. These research needs are described in more detail below.

In addition to conducting more research studies that take these considerations into account, there is a strong need for more effective knowledge mobilization of the available research evidence. Knowledge mobilization refers to all activities involved in sharing knowledge between researchers, knowledge brokers and knowledge users to create a positive impact by advancing knowledge on a particular subject (Social Sciences and Humanities Research Council, 2019). Considering the discrepant advice about cannabis use during pregnancy from dispensaries compared to information shared by health care providers, there is a need to close this gap in knowledge between researchers, practitioners, distributors and cannabis users. Generating new evidence on the health effects and risks of cannabis on its own is not sufficient to stimulate appropriate responses such as policy action or changes in behaviour – the evidence must be made available, accessible, and useful to policymakers, practitioners, and the public to help inform more knowledgeable decision-making and practices based on reliable and appropriate information (see section 9.4 for further discussion of policy implications).

Specific research needs:

1) First, there is a need for more research on sex, gender and cannabis use. Sex and gender should be considered in study design and survey measures to allow for analyses based on these factors, and should be incorporated into research reporting (Greaves et al., 2019). This will improve our understanding and knowledge of patterns of cannabis use and health effects relevant to women, particularly women who are pregnant or breastfeeding, while helping to inform public education and prevention efforts.

2) To provide a clearer understanding of the health effects of cannabis, studies must adequately control for confounding variables such as socio-economic status as well as other drugs and substances such as alcohol and tobacco that are often used concurrently with cannabis. The inability to investigate the independent effects of cannabis limits the development of a sound body of research that policymakers and healthcare practitioners can utilize to disseminate valuable information to the public and patients.

3) The majority of existing research has focused on traditional forms of cannabis consumption (e.g., smoking) and types (e.g., plant). However, the legalization of recreational cannabis in 2018 and edibles and other associated cannabis products in October 2019 has drastically altered the cannabis market by providing consumers with a greater variety of cannabis products. Although edibles are perceived as a safe means to attaining the same effects of smoking cannabis without the associated negative consequences, the delayed onset of the drug's effects with ingestion *may* prove that edibles pose a higher health risk than initially believed and pose a significant risk to children who may accidentally ingest these products found in their home. For these reasons, edibles and other non-traditional forms and types of cannabis, including CBD products, should be considered prime topics for further research and public education campaigns. In addition, not only is the issue of direct cannabis use of various forms a concern among pregnant women, but they may also be indirectly exposed to cannabis smoke or vapour – which contains many of the same chemicals as tobacco smoke – from other household members or even in public places. More research is needed on the health effects of exposure to second-hand cannabis smoke among nonusers, particularly for pregnant women, the fetus and children.

4) Future research should also consider the effects of the various strains of cannabis and potency levels. The issue of potency is of particular importance because THC content has significantly increased over the years and is grossly underestimated, particularly in the consumption of alternative types of cannabis products infused with cannabis, such as edibles. As noted in Section 9.2, existing research does not fully account for the consequences of exposure to high THC levels on the body and brain and the extent to which cannabis users adjust for increased potency (US NIDA, n.d.).

5) Research methods for studying cannabis use and effects during pregnancy are limited by various authorization and approval processes in Canada. For example, the *Cannabis Act* lays out the requirements for obtaining a federal licence for conducting research with cannabis, with different policies in place for clinical trials and observational studies. Due to these challenges, most research studies have mainly relied on self-report measures or retrospective analyses to track cannabis consumption during pregnancy (Singh et al., 2021). Despite their advantages, issues of validity and reliability with self-report can seriously compromise data and research findings. For these reasons, the exploration of alternative monitoring and evaluation measures is highly recommended. Recognizing that people may under-report their consumption of cannabis, particularly when cannabis is purchased from illegal distributors, Statistics Canada (2018b) has begun tracking cannabis consumption using wastewater-based epidemiology (WBE) to produce cannabis statistics, a technique used in Europe since 2007 to assess consumption of various drugs. WBE involves testing samples from wastewater treatment plants, generally those in large urban cities, for levels of THC. Other innovative techniques that have emerged involve testing biological samples such as serum, hair, urine, blood and saliva samples of female cannabis users (Ontario Agency for Health Protection and Promotion [OAHPP], 2018: 9). Meconium, the first stool of a newborn, has been used to measure cannabis exposure in infants (OAHPP, 2018: 9). However, the high costs associated with these methods, along with their limited applicability, high rates of false positives and ethical limitations, have discouraged their use in research (OAHPP, 2018: 9). Further research to identify more reliable and effective measures for tracking cannabis consumption is critical to producing sound evidence-based research.

6) Most existing cannabis research has been cross-sectional; however, there is a need for more longitudinal studies, particularly as Canada's cannabis market and users mature. Longitudinal studies have the benefit of tracking the same group of cannabis users over an extended time, compared to a brief period. The International Cannabis Policy Study is one recent example of a longitudinal cohort study that examines the impact of cannabis legalization in Canada over time by conducting annual follow-up surveys among a sample of new and returning respondents. Longitudinal studies are particularly effective for evaluating risk factors and disease progression (Caruana et al., 2015). Porath et al. (2018) found longitudinal studies effective in allowing for a reliable measure of the extent and timing of cannabis exposure during pregnancy as well as lifestyle variables, and an accurate assessment of developmental changes in children's behaviour and functioning over time.

7) Lastly, the growing use of cannabis is contributing to the prevalence of cannabis-related disorders such as Cannabis Use Disorder (CUD) and Cannabis Withdrawal Syndrome

(CWS). If left untreated, cannabis-related disorders are highly comorbid and disabling conditions that have harmful consequences both for individuals, particularly pregnant women, and broader society (Livne et al., 2019; Patel, 2019; Hasin et al., 2015; Katz et al, 2014). It is expected that the increasing availability and use of cannabis following legalization in Canada and other jurisdictions will further increase the prevalence and disease burden of CUD, including among pregnant populations (Jutras-Aswad et al. 2019). Yet despite this growing health risk, there is a lack of research on CUD prevalence and impact in Canada, especially among pregnant women. The existing research on CUD is also limited by differences in definitions and criteria across studies, as not all studies follow the latest guidelines for diagnosing CUD according to the DSM-5. Other studies rely on hospital records to determine the prevalence of CUD, which may result in misclassification or underestimation of prenatal CUD (Shi et al., 2021). Further research is needed to improve the measures used to screen for and assess CUD, as well as research to develop and assess various treatment options for CUD, such as pharmacological interventions (Compton et al., 2019; Jutras-Aswad et al. 2019).

9.4 Policy Implications

Implications for cannabis distributors and other primary contact points, including pharmacists:

Unlike other substances such as alcohol and tobacco, accessing reliable and reputable information regarding the safety and potential adverse effects of cannabis use during pregnancy remains a significant challenge for the public, often leading individuals to seek out unreliable sources for information. In some cases, the issue is not the availability of information but rather the quality of information available for decision making. In the absence of robust evidence, healthcare providers and cannabis distributors may allow their own personal beliefs or perceptions to influence the guidance they provide to pregnant women (Singh et al., 2021). For example, in the state of Colorado, some cannabis dispensaries have been actively promoting cannabis as a safe and effective cure for nausea and morning sickness in pregnancy, despite contradictory scientific evidence and without recommendations for further consultations with authorized healthcare professionals (Dickson et al., 2018).

Given that cannabis consumers often seek out information from sources other than health professionals, it is important for anyone involved in the provision of cannabis products or information to consumers to be well educated and trained in order to provide informed advice. Following the legalization of recreational cannabis and the introduction of edibles to the legal cannabis market in October 2019, many professional bodies have made cannabis education mandatory for frontline workers. For example, as part of its cannabis strategy to develop and maintain the competency of its members regarding the evolving cannabis market while ensuring the health and safety of patients, the Ontario College of Pharmacists requires practicing community and hospital pharmacists and pharmacy educators to complete a mandatory cannabis educational program designed to address: a pharmacist's ethical, legal and professional responsibilities surrounding cannabis and cannabis-related issues; patient care; and the application of knowledge and

research concerning the benefits and risks of cannabis, dosage and common side effects. [32] Although pharmacists cannot dispense cannabis under existing cannabis regulations, they are increasingly becoming the first point of contact for advice by patients about how cannabis interacts with medications and the associated risks and benefits of cannabis. [33]

Employees at retail stores and dispensaries are another primary point of contact for consumers. Currently, regulations for retail sales and distribution of cannabis are under provincial/territorial responsibility, so requirements such as education and training for cannabis distributors and retail store employees differ across jurisdictions. For example, in Ontario, all cannabis retail store employees and managers are required to complete an approved training program to support the safe sale and consumption of cannabis under the 2018 Cannabis Licence Act and regulations.

Implications for healthcare providers:

The lack of consistent, evidence-based guidance on cannabis use during pregnancy as well as the ease by which misinformation can be provided and accessed has helped to fuel the perception that the consumption of cannabis during pregnancy is safe and effective for treating various ailments (Singh et al., 2021). For example, as noted in Section 6.2, studies on cannabis harm perceptions among pregnant women have shown that the lack of communication and counseling from healthcare providers leads women to believe that the risks associated with cannabis use during pregnancy must not be significant (Bayrampour et al., 2019). For this reason, healthcare professionals, particularly frontline healthcare workers such as local public health nurses, play a vital role in reducing these misperceptions by educating the public and expectant mothers with adequate and reliable information about the potential risks associated with any form of cannabis consumption during pregnancy, including edibles and CBD products — especially for more frequent and prolonged use (Singh et al., 2021).

Additional considerations for healthcare providers in addressing cannabis use during pregnancy based on the literature include:

- Patients should be provided with alternative options for managing symptoms during pregnancy that are safer and medically approved (Young-Wolff et al., 2019).
- Given the increasing use of cannabis among all women, educational and prevention efforts should begin for women of reproductive age even before they are pregnant to be most effective (Young-Wolff et al., 2019).
- In addition, since many pregnant women do not disclose their cannabis consumption to health care providers by self-report methods, health providers and clinicians should ensure that all pregnant women – not only those who report using cannabis – are informed about the potential risks and given advice to avoid or stop using cannabis prenatally (Young-Wolff et al., 2020).

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[32] The *Cannabis Strategy for Pharmacy: Enhancing Knowledge, Protecting Patients* can be accessed through the College's website at http://www.ocpinfo.com/about/key-initiatives/cannabis-strategy-for-pharmacy/. Information regarding the College's mandatory training program can be accessed at http://www.ocpinfo.com/practice-education/practice-tools/support-materials/cannabis-training-requirements-courses/.

[33] Under existing federal cannabis regulations for medical cannabis, medicinal cannabis can only be purchased by patients through mail order from Health Canada licensed producers. In January 2019, following approval by Health Canada to sell medicinal cannabis on-line, Shoppers's Drugmart launched its e-commerce platform for the sale of medicinal marijuana in Ontario. Patients must adhere to strict requirements before they will be dispensed cannabis.

- A non-judgemental, unbiased, and compassionate approach to addressing the issue of cannabis use during pregnancy by healthcare professionals can also help to encourage discussion, thereby improving outcomes for mother and fetus (Ordean et al., 2017; Porath et al., 2018).

The role of health professionals is especially important in preventing and addressing the growing prevalence of cannabis-related disorders, including CUD and CWS. Some researchers have suggested that the increasing legal and social acceptance and availability of cannabis in recent years along with perceptions of low harm may result in underestimates of the prevalence of CUD according to self-reported symptoms and criteria (Compton et al., 2019; Jutras-Aswad et al., 2019). Greater efforts to improve the diagnosis and identification of CUD in pregnant patients, such as using more objective screening criteria, would help to better understand patient needs and ensure appropriate education and care. In addition to educating the public on cannabis-related disorders as part of prevention efforts, healthcare professionals must also provide the necessary services and supportive care to help reduce or discontinue use among those already affected, such as comprehensive mental health and/or trauma services and referrals to other resources or programs, such as addiction care (Ordean et al., 2017). Given the current lack of effective treatments and programs for CUD (e.g. pharmacological treatments), further research to develop and evaluate treatment options for CUD would be valuable (Jutras-Aswad et al., 2019). Harm reduction approaches for managing CUD or other substance use disorders among pregnant women could also be considered for those unable to quit (Badowski & Smith, 2020; Ordean et al., 2017).

Implications for policymakers:

The success of universal health education efforts regarding cannabis use and pregnancy will require policymakers to provide the necessary resources (i.e. funding, training and development opportunities) and to take an active role in collecting, monitoring and sharing evidence that contributes to public health (Lung Health Foundation, 2018). This would help to ensure that healthcare professionals are well-versed in the latest developments in the field, enabling them to provide patients with the appropriate evidence-based information and support necessary to make informed decisions regarding their health and their child's health.

Since the legalization of recreational cannabis in 2018 and medicinal cannabis in 2001, the Government of Canada has taken an active role to improve the quality of health advice provided by public health professionals by monitoring, collecting and distributing valuable data regarding the social, economic, legal and health outcomes of both recreational and medicinal cannabis use in Canada. For example, the development of the Integrated Cannabis Research Strategy (ICRS), an initiative of the Canadian Institutes of Health Research (CIHR), is designed to position Canada as a world leader in cannabis research for the development of policy and regulatory models for non-medical use (Canadian Institutes of Health Research, 2019).

Besides advice from health professionals, wider educational and media campaigns can be an important strategy for reaching consumers and raising awareness about the health effects and risks associated with cannabis use. In particular, digital media may be an effective method for targeting young people (Leos-Toro et al., 2020). Health Canada has taken steps to enhance public education campaigns related to cannabis, including a reported investment of $100 million for cannabis public education, awareness, and surveillance over six years following the legalization of cannabis (The Canadian Press, 2018).

9.5 Conclusion

Canada's cannabis market is still in its infancy, and little is known about the safety and specific health effects of cannabis consumption, particularly during pregnancy and postpartum, including breastfeeding (Badowski & Smith, 2020). As the cannabis market evolves and matures in Canada and other jurisdictions, so will our understanding of the associated risks and benefits of all forms and types of cannabis products. Policymakers and healthcare professionals will continue to play a pivotal role in raising greater awareness about cannabis use and prenatal cannabis exposure by educating the public and counseling patients on the potential effects of cannabis, whether used for recreational or medical purposes, to ensure informed decisions are made that promote the health and well-being of all Canadians.

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Appendix A: Summary of Relevant Conclusions from "The Health Effects of Cannabis and Cannabinoids: The Current State of Evidence and Recommendations for Research" (NASEM, 2017).

Chapter 4 Conclusions: Therapeutic Effects of Cannabis and Cannabinoids

There is conclusive or substantial evidence that cannabis or cannabinoids are effective:	• **For the treatment of chronic pain in adults (cannabis)** • **As antiemetics in the treatment of chemotherapy-induced nausea and vomiting (oral cannabinoids)** • **For improving patient-reported multiple sclerosis spasticity symptoms (oral cannabinoids)**
There is moderate evidence that cannabis or cannabinoids are effective for:	• Improving short-term sleep outcomes in individuals with sleep disturbance associated with obstructive sleep apnea syndrome, fibromyalgia, chronic pain, and multiple sclerosis (cannabinoids, primarily nabiximols)
There is limited evidence that cannabis or cannabinoids are effective for:	• Increasing appetite and decreasing weight loss associated with HIV/AIDS (cannabis and oral cannabinoids) • Improving clinician-measured multiple sclerosis spasticity symptoms (oral cannabinoids) • Improving symptoms of Tourette syndrome (THC capsules) • Improving anxiety symptoms, as assessed by a public speaking test, in individuals with social anxiety disorders (cannabidiol) • Improving symptoms of posttraumatic stress disorder (nabilone; a single, small fair-quality trial)
There is limited evidence of a statistical association between cannabinoids and:	• Better outcomes (i.e., mortality, disability) after a traumatic brain injury or intracranial hemorrhage
There is limited evidence that cannabis or cannabinoids are *ineffective* for:	• Improving symptoms associated with dementia (cannabinoids) • Improving intraocular pressure associated with glaucoma (cannabinoids) • Reducing depressive symptoms in individuals with chronic pain or multiple sclerosis (nabiximols, dronabinol, and nabilone)
There is no or insufficient evidence to support or refute the conclusion that cannabis or cannabinoids are an effective treatment for:	• Cancers, including glioma (cannabinoids) • Cancer-associated anorexia cachexia syndrome and anorexia nervosa (cannabinoids) • Symptoms of irritable bowel syndrome (dronabinol) • Epilepsy (cannabinoids) • Spasticity in patients with paralysis due to spinal cord injury (cannabinoids) • Symptoms associated with amyotrophic lateral sclerosis (cannabinoids) • Chorea and certain neuropsychiatric symptoms associated with Huntington's disease (oral cannabinoids)

	• Motor system symptoms associated with Parkinson's disease or the levodopa-induced dyskinesia (cannabinoids)
	• Dystonia (nabilone and dronabinol)
	• Achieving abstinence in the use of addictive substances (cannabinoids)
	• Mental health outcomes in individuals with schizophrenia or schizophreniform psychosis (cannabidiol)

Chapter 10 Conclusions: Effects of Prenatal, Perinatal & Neonatal Exposure to Cannabis

There is substantial evidence of a statistical association between maternal cannabis smoking and:	• **Lower birth weight of the offspring**
There is limited evidence of a statistical association between maternal cannabis smoking and:	• Pregnancy complications for the mother • Admission of the infant to the neonatal intensive care unit (NICU)
There is insufficient evidence to support or refute a statistical association between maternal cannabis smoking and:	• Later outcomes in the offspring (e.g., sudden infant death syndrome, cognition/academic achievement, and later substance use)

Appendix B: Latest Policy Positions and Recommendations on the Use of Cannabis During Pregnancy of Key Canadian, American, and International Health Organizations

Organization	Policy Position/Recommendation(s)
CANADA	
Canadian Centre on Substance Use and Addiction Source: Porath, Konefal & Kent (2018).	"[I]t is prudent to advise pregnant women and women thinking of becoming pregnant of the risks associated with cannabis use during pregnancy. Little is known about the effects of cannabis exposure through other routes of administration. However, there is no determined amount of cannabis exposure that is safe and until the effects of prenatal cannabis exposure are well understood, the safest option available to pregnant women is to avoid using cannabis." "Experts recommend against using any type of cannabis during pregnancy or breastfeeding… Appropriate counseling services, however, should be offered to nursing mothers who are not able to stop using cannabis as the benefits of breastfeeding can still outweigh the possible harms of exposure from occasional cannabis use."
College of Family Physicians of Canada Source: Badowski & Smith (2020).	"There is no known safe level of cannabis use during pregnancy or lactation. Pregnant women should be counseled regarding the risks of in utero exposure and encouraged to abstain from use in pregnancy and while breastfeeding."
Society of Obstetricians and Gynaecologists of Canada Source: Society of Obstetricians and Gynaecologists of Canada (n.d.).	"The Society of Obstetricians and Gynaecologists of Canada (SOGC) is concerned that legalization of cannabis may overshadow a growing body of medical research which suggests that the use of cannabis during pregnancy may be associated with the risk of low birth weight, preterm labour, stillbirth and may also negatively impact the developing baby's brain… Our recommendation is to avoid cannabis during pregnancy and seek other alternatives to reduce nausea. And for women who use cannabis for medical reasons, we advise them to talk to their health care provider."
Canadian Association of Midwives Source: Canadian Association of Midwives (2018).	"Evidence suggests there is a possibility of adverse health effects on the pregnant person, fetus, and breastfed baby. Further research is needed to better understand the long-term health effects of cannabis consumption in any form. Smoking any substance during pregnancy is associated with lower birth weight. "There is no known safe amount of cannabis use during pregnancy or breastfeeding. In the absence of clear data, we

	discourage the use of cannabis for pregnant and lactating people as the effects are unclear. Further research is needed to allow people to make better informed decisions."
Health Canada Source: Health Canada (2018 & 2019).	"Cannabis is not recommended to treat morning sickness or for medical purposes during pregnancy. Ask a health care provider about safer options to feel better." "There is no known safe amount of cannabis use during pregnancy or breastfeeding. The safest approach is to not use cannabis."
UNITED STATES	
American Academy of Pediatrics Source: Ryan, Ammerman and O'Connor (2018).	"Women of reproductive age who are pregnant or planning to become pregnant and are identified through universal screening as using marijuana should be counseled and, as clinically indicated, receive brief intervention and be referred to treatment... it is important to advise all adolescents and young women that if they become pregnant, marijuana should not be used during pregnancy." "Pregnant women who are using marijuana or other cannabinoid-containing products to treat a medical condition or to treat nausea and vomiting during pregnancy should be counseled about the lack of safety data and the possible adverse effects of THC in these products on the developing fetus and referred to their health care provider for alternative treatments that have better pregnancy-specific safety data." "Women who have become abstinent from previous marijuana use should be encouraged to remain abstinent while pregnant and breastfeeding"
Academy of Breastfeeding Medicine Source: Reece-Stremtan, Marinelli and The Academy of Breastfeeding Medicine (2015)	"The lack of long-term follow-up data on infants exposed to varying amounts of marijuana via human milk, coupled with concerns over negative neurodevelopmental outcomes in children with in utero exposure, should prompt extremely careful consideration of the risks versus benefits of breastfeeding in the setting of moderate or chronic marijuana use. A recommendation of abstaining from any marijuana use is warranted."
American Society of Addiction Medicine Source: American Society of Addiction Medicine (2020).	"Healthcare professionals should avoid recommending cannabis to pregnant persons." "Women who are pregnant or contemplating pregnancy should be encouraged to or avoid or discontinue cannabis use. Cannabis

	use during lactation and breastfeeding should also be discouraged as there are insufficient data to evaluate its effect on infants."
American College of Obstetricians and Gynecologists Source: American College of Obstetricians and Gynecologists (2017).	"Because of concerns regarding impaired neurodevelopment, as well as maternal and fetal exposure to the adverse effects of smoking, women who are pregnant or contemplating pregnancy should be encouraged to discontinue marijuana use." Obstetrician–gynecologists should be discouraged from prescribing or suggesting the use of marijuana for medicinal purposes during preconception, pregnancy, and lactation. Pregnant women or women contemplating pregnancy should be encouraged to discontinue use of marijuana for medicinal purposes in favor of an alternative therapy for which there are better pregnancy-specific safety data. There are insufficient data to evaluate the effects of marijuana use on infants during lactation and breastfeeding, and in the absence of such data, marijuana use is discouraged."
INTERNATIONAL	
World Health Organization Source: WHO (2014).	"Health-care providers should, at the earliest opportunity, advise pregnant women dependent on alcohol or drugs to cease their alcohol or drug use and offer, or refer to, detoxification services under medical supervision where necessary and applicable."

Appendix C: Studies on The Potential Adverse Health Effects of Maternal Cannabis Use on The Fetus

Author(s)	Short-term and Long-term Outcomes
Bolhuis et al. (2018)	Both maternal and paternal cannabis use were associated with more offspring psychotic-like experiences at age ten years.
Brar et al. (2019)	The findings showed that daily marijuana use was associated with impaired fetal growth and increased placental vascular resistance.
Brown & Graves (2013)	Cigarette and marijuana smoke have been implicated in developmental and hyperactivity disorders in children.
Brown et al. (2016)	Cannabis use during pregnancy led to increased risk of low birth weight and increased likelihood of being small for their gestational age.
Chakraborty et al. (2015)	Results demonstrate that prenatal drug exposure can influence a behavioural measure of visual development, but that the effects are dependent on the specific drugs used during pregnancy.
Conner et al. (2016)	Marijuana use during pregnancy was associated with an increased risk of preterm delivery and low birth weight.
Corsi, et al. (2019)	Cannabis exposure was significantly associated with greater frequency of small for gestational age, placental abruption, and transfer to neonatal intensive care.
Crume et al. (2018)	Prenatal cannabis use was associated with a 50 percent increased likelihood of low birth weight.
Day et al. (1992)	Neither tobacco nor marijuana use predicted gestational age or morphological abnormalities.
Day et al. (2010)	Prenatal marijuana exposure significantly predicted child depressive symptoms and attention problems at age 10 and offspring of heavier marijuana users were significantly more likely to report delinquent behavior at age 14
De Genna et al. (2018a)	Maternal trajectories of co-use were associated with inter-generational transfer of risk for substance use and dependence in adult offspring.
De Genna, et al. (2018b)	One implication of these findings is that the inter-generational risk for tobacco use conferred via gestational exposures to tobacco and cannabis generalizes to novel products such as electronic cigarettes.
de Moraes-Barros et al. (2006)	Marijuana exposure during pregnancy was found to alter the neurobehavioral performance of term newborn infants of adolescent mothers.
Dotters-Katz (2017b)	Among infants born <35 weeks of gestation, marijuana exposure was not associated with adverse neonatal or childhood outcomes.
Eiden et al. (2018)	Maternal sensitivity was modestly stable from infant to toddler period and predicted higher toddler emotion regulation. Co-exposure predicted poor autonomic regulation in infancy, which in turn predicted poor toddler emotion regulation.
El Marroun (2018a)	Findings showed associations of maternal cannabis use during pregnancy with offspring externalizing problems but not with internalising problems.

Fried & Makin (1987)	Prenatal marijuana exposure was associated with increased tremors, startles and poorer habituation to visual stimuli.
Fried & Smith (2001)	During the toddler stage, there is little evidence for a prenatal marijuana effect either upon growth or behavior. Beyond the age of three, there is a confluence of findings from widely differing cohorts suggestive of a putative association between prenatal marihuana exposure and aspects of cognitive behavior that fall under the umbrella of EF — a construct that is mediated primarily by the prefrontal region of the brain.
Goldschmidt et al. (2004)	Exposure to one or more marijuana joints per day during the first trimester predicted deficits in Wide Range Achievement Test-Revised (WRAT-R) reading and spelling scores and a lower rating on the teachers' evaluations of the children's performance at the ten-year follow-up. Second-trimester marijuana use was significantly associated with reading comprehension and underachievement.
Goldschmidt et al. (2016)	Early age on onset marijuana was significantly associated with negative adult roles including increased risk of being arrested, lower educational attainment, having a child without being married and unemployment at 22 years.
Grant et al. (2018)	The neurodevelopmental data in humans and animals suggest that prenatal exposure to THC may lead to subtle, persistent changes in targeted aspects of higher-level cognition and psychological well-being.
Grzeskowiak et al. (2020)	Infants of mothers who still used cannabis at 15 weeks had lower birthweight, head circumference, birth length, and gestational age at birth, with even greater differences for those who used cannabis more frequently (more than once/week). The odds of severe infant morbidity or death increased with persistence of cannabis use during pregnancy.
Gunn et al. (2016)	Infants exposed to cannabis in utero had a decrease in birth weight compared with infants whose mothers did not use cannabis during pregnancy. Infants exposed to cannabis in utero were also more likely to need placement in the neonatal intensive care unit compared with infants whose mothers did not use cannabis during pregnancy.
Hayatbakhsh et al. (2012)	Cannabis use in pregnancy was associated with low birth weight, preterm labor, small for gestational and admission to the neonatal intensive care unit.
Howard et al. (2019)	Cannabis use was negatively correlated with fetal birth weight in patients who tested positive for THC when compared with those who did not as documented in the urine drug screens.
Huizink (2014)	Cannabis use both during pregnancy and lactation, may adversely affect neurodevelopment, especially during periods of critical brain growth both in the developing fetal brain and during adolescent maturation, with impacts on neuropsychiatric, behavioural and executive functioning.

Huizink & Mulder (2006)	Most studies indicate that low to moderate maternal and cannabis use during pregnancy may contribute to neurobehavioral and cognitive deficits in the offspring.
Janisse et al. (2014)	Alcohol, cigarette, and cocaine use were all individually and negatively related to gestational age at delivery. However, only alcohol, cigarette, and marijuana use predicted fetal growth, with effects for alcohol and cigarette greater and more discrepant for older women. Overall, heavy cigarette smoking had the greatest individual impact on birth weight.
Jaques et al. (2014)	Current evidence indicates that cannabis use both during pregnancy and lactation may adversely affect neurodevelopment, especially during periods of critical brain growth both in the developing fetal brain and during adolescent maturation, with impacts on neuropsychiatric, behavioural and executive functioning.
Jutras-Aswad et al. (2009)	Both human longitudinal cohort studies and animal models strongly emphasize the long-term influence of prenatal cannabinoid exposure on behavior and mental health.
Kalant (2004)	In total, the evidence indicates that regular heavy use of cannabis carries significant risks for the individual user and for the health care system.
Ko et al. (2018)	Prenatal marijuana use was not independently associated with lower average birth weight or gestational age. Postpartum marijuana use was associated with depressive symptoms and shorter breastfeeding duration.
Leemaqz et al. (2016)	Continued maternal marijuana use at 20 weeks' gestation was associated with spontaneous preterm births, independent of cigarette smoking status and socioeconomic index.
Luke et al. (2019)	Cannabis use in pregnancy is associated with small-for-gestational-age, spontaneous preterm birth, and intrapartum stillbirth.
Marroun et al. (2011)	Results suggest that intrauterine exposure to cannabis was associated with an increased risk for aggressive behavior and attention problems as early as 18 months of age in girls, but not boys.
Merlob et al. (2017)	Marijuana does not appear to be a major teratogen; however, a small increased risk for some congenital birth defects may be associated with early pregnancy use.
Metz & Stickrath (2015)	Marijuana freely crosses the placenta and is found in breast milk. It may have adverse effects on both perinatal outcomes and fetal neurodevelopment. Specifically, marijuana may be associated with fetal growth restriction, stillbirth, and preterm birth.
Metz et al. (2017)	Maternal marijuana use was not associated with a composite of small for gestational age, spontaneous preterm birth, or hypertensive disorders of pregnancy. However, it was associated with an increased risk of neonatal morbidity.
Murnan et al. (2020)	Compared to non-exposed children, children with prenatal marijuana exposure had more sleep-related problems, withdrawal symptoms, and externalizing problems, including aggressive behaviors and oppositional defiant behaviors.

Paul et al. (2020)	The study suggests that prenatal cannabis exposure and its correlated factors are associated with greater risk for psychopathy during middle childhood.
Petrangelo et al. (2018)	Compared with the reference population, women reporting cannabis use were at a significantly higher risk of having a preterm premature rupture of membranes and miscarriage. Neonates born to exposed mothers were at a higher risk of being born prematurely and growth restricted.
Petrangelo et al. (2019)	Users of cannabis during gestation were more likely to have adverse outcomes during delivery and require longer periods of hospitalization. Neonates born to exposed mothers were more likely to be born preterm and underweight.
Sasso et al. (2021)	Antepartum marijuana use was significantly associated with cesarean delivery, SGA and supplemental oxygen use at birth.
Shi et al. (2021)	Prenatal cannabis use disorder was associated with greater odds of small for gestational age, preterm birth, low birth weight, and death within 1 year of birth.
Sonon et al. (2014)	Prenatal marijuana exposure was associated with subsequent marijuana use in the offspring's young adulthood (after a 22-year assessment).
Smith et al. (2016)	Alterations in neurophysiological functioning of young adults prenatally exposed to marijuana were demonstrated by significantly more brain activity in the prenatally exposed offspring (18–22-year-olds) compared to the non-exposed group.
Stroud et al. (2018)	Marijuana and tobacco exposed infants showed decreased ability to self-soothe, attend to stimuli, increased need for examiner soothing and low motor activity versus unexposed infants.
Sun & Dey (2014)	Maternal consumption of marijuana or synthetic cannabinoids was found to be a potential risk factor for abnormal embryo development, tubal pregnancy, implantation failure, placental defects related to spontaneous abortion and preterm birth.
Van Gelder et al. (2009)	Periconceptional cannabis use seemed to be associated with an increased risk of anencephaly.
van Gelder et al. (2014)	Cannabis use was associated with esophageal atresia, diaphragmatic hernia and gastroschisis.
Varner et al. (2014)	Cannabis use, smoking, illicit drug use, and apparent exposure to second-hand smoke, separately or in combination, during pregnancy were associated with an increased risk of stillbirth.
Warshak et al. (2015)	Maternal marijuana use did not increase the risk of adverse obstetrical outcomes or fetal anomalies but did increase the risk for small for gestational age and neonatal intensive care unit admission.
Willford et al. (2010)	Prenatal marijuana exposure significantly predicted deficits in bimanual coordination and movement, processing speed and interhemispheric transfer of information.
Zammit et al. (2009)	Frequency of maternal tobacco use during pregnancy was associated with increased risk of suspected or definite psychotic symptoms in offspring.