



CANNABIS USE IN PREGNANCY:

Examining the impact on
infant and child mental health

Evidence summary



Ontario Centre of Excellence
for Child & Youth Mental Health

Centre d'excellence de l'Ontario en santé
mentale des enfants et des adolescents

August 2021



Suggested citation:

Kurzawa, J. & Brown, J. (2021). *Cannabis use in pregnancy: Examining the impact on infant and child mental health. Evidence Summary*. Ontario Centre of Excellence for Child and Youth Mental Health. <https://www.cymh.ca/cannabis-pregnancy>

For information about this report, contact Dr. Jaime Brown at jbrown@cheo.on.ca.



Table of contents

At a glance.....	4
Background	5
Method	8
Findings	9
Discussion	13
References	15

At a glance

What did we want to know?

We wanted to understand the impact of cannabis, when used by people who are pregnant or nursing, on the mental health of infants and children.

Why did we want to know this?

- The evidence will better equip mental health service providers who support children, young people and families affected by substance use.
- This is a pressing concern. The rates of cannabis use among people who are pregnant or nursing are rising steadily, and there are concerns the COVID-19 pandemic could further influence substance use.

What did we learn?

Infants exposed to cannabis — in-utero, through nursing or both — may experience the following:

- withdrawal symptoms (increased startle response, tremors and irritability)
- increased externalizing behaviour (hyperactivity, impulsivity, aggression)
- deficits in executive functioning (memory, verbal reasoning, reading, attention)
- challenges with self-regulation

These early behaviours may predispose children to develop later mental health challenges such as depression, anxiety and psychosis.

How did we learn this?

We conducted a non-systematic scan of peer-reviewed research using keywords including marijuana, cannabis use, pregnancy, infant and mental health. The scan was conducted in April 2021 and focused on studies over the past 20 years.

Are there any gaps?

Historically, research on cannabis exposure in infants and children has focused on cognitive development. Literature examining exposure on infant and child mental health is limited, however, and there are many gaps in knowledge. In the absence of high-quality longitudinal studies in the past 20 years, we broadened our inclusion criteria to include two large population-based longitudinal studies initiated in the 1970s and 1980s.

Further research is needed to understand how dose, consumption method and other factors influence mental health outcomes for this population.

Background

Cannabis consumption

Cannabis is the most widely used drug, with approximately 192 million users worldwide (United Nations Office on Drugs and Crime, 2020). In a 2021 survey of Canadians, 16 percent of respondents indicated they had consumed cannabis in the past month (Statistics Canada, 2021).

Cannabis may be consumed in many forms, including by smoking the dried flower or leaf, vaping the oil, using oral sprays, applying topical lotions or consuming it when it is processed into food (Government of Canada, 2020). While there are many chemicals in cannabis, tetrahydrocannabinol (THC), the active chemical in cannabis that is responsible for the feeling of euphoria or “high,” is the most controversial (Grinspoon, 2018).

Using cannabis during pregnancy and postpartum is not recommended due to risk of exposure in-utero or when nursing (Badowski & Smith, 2020; Carsley & Leece, 2018; Dahan et al., 2020; Government of Canada, 2019; Thompson et al., 2019). Unlike alcohol, the active ingredients in cannabis can linger in the body for weeks and pass readily to the fetus through the placenta or to the infant through human milk (Thompson et al., 2019).

A sizeable body of literature points to the effect of cannabis on developmental outcomes such as low birth weight and increased admission to neonatal intensive care (Corsi et al., 2019; Dahan et al., 2020; Gunn et al., 2016).

There is also a limited but growing body of literature pointing to impacts on infant and early childhood mental health (Fried & Smith, 2001; Thompson et al., 2019). Prenatal and early postnatal periods are critical in brain development. Exposure to certain stimuli such as nutrients, stress or substances can have long-lasting implications (Calvigioni et al., 2014).

Despite the potential risks, we know that some people who are pregnant or nursing do use cannabis (Badowski & Smith, 2020). In Canada, self-reported rates of cannabis use in pregnancy range from two to 6.5 percent; however, this is likely under-reported due to stigma and self-reporting bias (Corsi et al., 2019; Badowski & Smith, 2020). Use among pregnant people is growing. An Ontario study found that from 2012 to 2017, cannabis use among pregnant people had increased from 1.2 percent to 1.8 percent — a relative increase of 61 percent (Corsi et al., 2019).

Rates of use during pregnancy tend to be higher among people with low socioeconomic status (El Marroun et al., 2010; Passey et al., 2014). The same Ontario study as above showed 54.7 percent of pregnant cannabis users were in the lowest two income quintiles (Corsi et al., 2019).

There is a need to discern how in-utero cannabis exposure or exposure through nursing affects the early mental health of infants and children. This information will help service providers deliver tailored supports and services to children and families.

Context of cannabis use in Canada

In this evidence summary, we look at three factors believed to have led to an increase in cannabis use in Canada, namely:

- the perception that cannabis is safe
- the legalization of non-medical cannabis and ensuing social acceptability
- the COVID-19 pandemic

Safety

Rising rates of cannabis use among pregnant people correlate with increased perceptions of safety (Bayrampour et al., 2019). One study found that 70 percent of pregnant people believed there was little to no risk of harm in using cannabis once or twice a week (Ko et al., 2015). Research shows the impact of cannabis use on fetal development is largely dose-dependent, meaning the greater the dose, the greater potential for negative consequences (Badowski & Smith, 2020; Thompson et al., 2019).

The perception that cannabis is safe is likely due, in part, to the medical use of cannabis. Cannabis has been used as a traditional herbal medicine for thousands of years. In Canada, medical cannabis has been legal since 1999 and there is a large body of evidence pointing to its efficacy in treating a range of symptoms such as nausea, inflammation and seizures (Calvigioni et al., 2014). Most pregnant people who use medical cannabis report doing so to relieve nausea and vomiting associated with pregnancy (Westfall et al., 2006). Others use cannabis recreationally.

While many people consider cannabis safe (Ko et al., 2015), there is limited awareness of the increasing potency of THC. THC potency in cannabis has been steadily rising over the past two decades (ElSohley et al., 2016). Typical THC potency 20 years ago was three to five percent in smoked cannabis (Hall et al., 2019). However, this has risen to 15 percent in recent years (Hall et al., 2019). In cannabis concentrates, THC potency ranges from 39 percent to 69 percent (Meier et al., 2019).

Research shows there has been an increase in the production of synthetic cannabinoids, typically of higher potency than THC (Zawilska & Wojcieszak, 2014). While synthetic cannabinoids present risks, our evidence summary focuses on natural forms of cannabis.

Legalization

The legalization of non-medical cannabis in Canada in 2018 is believed to have increased social acceptability of the drug (Corsi et al. 2019; Government of Canada 2020; Hawley et al., 2020; Rotermann, 2020). A study on how the media portrays risks and benefits found that a third of advertisements cast cannabis use in pregnancy in a positive light (Jarlenski et al., 2018) in

contradiction to medical guidelines (Centre for Disease Control, 2018; Ryan et al., 2018). While we know there has been a small increase in use among the general population since cannabis was legalized (Roterman et al., 2020), clinicians stress that we will not know the full impact of legalization for another decade or so (Leyton et al., 2019).

COVID-19 pandemic

Questions have been raised about increased use of cannabis during the ongoing COVID-19 pandemic. We found no readily available literature estimating cannabis use among people who are pregnant or nursing. However, research does show a rise in use within the general population, with more than a third of adults who previously consumed cannabis reporting an increase in their consumption during the pandemic (Statistics Canada, 2021). This is in line with findings that economic recessions are associated with increased alcohol and substance use (Broguera et al., 2018).

Making the case

Together, these factors are believed to have increased the prevalence of cannabis use in people who are pregnant or nursing.

This information further highlights the urgency to understand the impact of cannabis use on the mental health of infants and children.

Method

Our research goal was to understand the impact of prenatal and early postnatal cannabis exposure — that is, when cannabis is used by people who are pregnant or nursing— on the mental health of infants and children newborn through age six.

Scope

To best support decision makers, we aimed to synthesize data in a timely manner. We conducted a rapid, non-systematic scan of peer-reviewed research literature, grey literature and practice guidelines. Titles and abstracts of peer-reviewed articles were screened for inclusion or exclusion. Subsequently, full articles were reviewed for relevance and incorporated into this document, and additional articles were gathered from review of references of screened articles. The search results reflect information available as of April 2021.

A keyword search was performed using the following terms or combinations of terms: maternal, marijuana, cannabis use, pregnancy, infant, child, mental health, COVID-19.

Data was collected using seven electronic databases: PubMed, PsycINFO, Medline, CINAHL, EMBASE, ERIC and Google scholar.

Inclusion criteria were as follows:

- research on infants and children (newborn through age six) exposed to cannabis in-utero or through human milk and reported on neurological, behavioural or mental health outcomes
- published between 2001 and 2021¹
- available in English or French
- published through pre-publication services, online or in print by peer-reviewed journals
- available in full-text format
- single studies, directive documents, guidelines, full systematic reviews (or review-derived products such as overviews of systematic reviews) and rapid reviews

State of the literature

Literature related to prenatal and early postnatal cannabis exposure on infant and early childhood mental health is limited. This is particularly the case if we confine the search to the past 20 years. We broadened our criteria to include two population-based longitudinal studies conducted more than 20 years ago: the Ottawa Prenatal Prospective Study (OPPS) initiated in 1978; and the Maternal Health Practices and Child Development Project (MHPCD) initiated in 1982. We compare these early findings to more current findings. Findings should be interpreted with caution.

¹ Due to the lack of high-quality literature on the topic, we broadened this criterion to include two earlier longitudinal studies.

Findings

Since infant and early childhood mental health issues often present as behaviours rather than formal diagnoses, we have framed our findings this way (Cohen et al., 2012). It should be noted that while certain behaviours in infancy and early childhood can be precursors to later mental health challenges, this is not always the case (Thompson et al., 2019).

Like opioids, parental cannabis use during pregnancy or while nursing has been linked to withdrawal symptoms in infants — increased startle response and tremors, for example. In infancy and early childhood, increased externalizing behaviours, deficits in executive functioning and challenges with self-regulation have been observed.

Startle response, tremors, irritability

Early studies demonstrate heightened tremors, irritability and startle response in infants whose parents were regular or heavy users of cannabis (Fried et al., 1980; Fried et al., 1987; Fried & Makin, 1987). Regular use was defined as two to five joints per week, and heavy use was defined as more than five joints per week. Tremors were more severe in infants whose parents were heavy users (Fried et al., 1980). These early findings are consistent with more recent studies that show infants exposed to cannabis display increased tremors, excitability, arousal and higher-pitched cries than unexposed infants (De Moraes Barros et al., 2006).

Putting this in context

- These findings indicate a possible impact on the central nervous system, similar to withdrawal symptoms in infants exposed to drugs or alcohol. The symptoms appear to resolve with time (Fried et al., 1987; The Hospital for Sick Children, 2009). However, the symptoms could negatively impact parent attachment.
- One study reported that “subtle differences in newborn behavior in the context of a less resourced parent may lead to a maladaptive cycle of continued behavioral dysregulation, further disruptions in parent-infant attachment, and eventually, long-term adverse offspring outcomes” (Stroud et al., 2018, p. 14).

Externalizing behaviours

Early studies of children exposed to cannabis demonstrate heightened externalizing behaviours — specifically, high scores in hyperactivity and impulsivity (Fried et al., 1992a). More recent studies support this finding; infants and children exposed to cannabis presented with greater impulsivity, hyperactivity and aggression than those who were not exposed (El Marroun et al., 2011; Goldschmidt et al., 2008; Paul et al., 2020). Increased aggression was observed only in females (El Marroun et al., 2011).

Putting this in context

- Externalizing behaviours are a group of maladaptive behaviours in response to the external environment. These behaviours include hyperactivity, impulsivity, aggression and delinquency (Liu, 2006).
- Externalizing behaviours are the primary reason for referral to child and youth mental health services (Mazzucchelli & Sanders, 2018) and are often precursors for later mental health challenges (Day et al., 2011; Farrington, 2021).

Executive functioning

The OPPS and the MHPCD studies found that prenatal cannabis exposure was associated with deficits in executive functioning, with low scores noted in verbal and memory tasks in early childhood (Fried & Watkinson, 1990; Fried & Smith, 2001; Day et al., 1994). This finding has been replicated in a more recent study (Goldschmidt et al., 2008). Heavy cannabis use, defined as one or more joint per day, was associated with reduced verbal reasoning and short-term memory (Goldschmidt et al., 2008). At school age (six years old), children continued to demonstrate deficits in verbal reasoning and memory (Goldschmidt et al., 2008).

Inattention is reported in infants as young as one month, although the study by Stroud and colleagues looked at co-tobacco and cannabis use, making it impossible to tease out the unique effects of cannabis (2018). Interestingly, a large population-based longitudinal study also found in-utero cannabis exposure was associated with increased attention problems in infancy, but only in female infants (El Marroun et al., 2011). Authors speculate that the impact on males' attention could become apparent later in development (El Marroun et al., 2011).

Putting this in context

- Executive functioning governs the way we think, retain information, shift our attention to different activities, and set and realize goals (Harvard University, 2021).
- Early deficits in executive functioning can be precursors to later mental health challenges, particularly attention deficit hyperactivity disorder (ADHD) and autism spectrum disorder (Otterman et al., 2019).

Self-regulation

Literature suggests that compared to unexposed infants, infants exposed to cannabis have a reduced ability to self-regulate (De Moraes Barros et al., 2006; Fried et al., 1980; Stroud et al., 2018) and a greater need for external soothing (Stroud et al., 2018). De Moraes Barros and colleagues also found that infants were less responsive to attempts to soothe them (2006). Wang and colleagues provide further insight and support of reduced self-regulation skills, finding that fetuses exposed to cannabis had impaired dopamine gene expression affecting the amygdala (2004), suggesting that these changes begin prenatally.

Putting this in context

- The amygdala — a collection of cells near the base of the brain — plays a central role in emotional regulation (Wang et al., 2004). The finding that cannabis impacts the amygdala in-utero suggests that infants exposed to cannabis may be predisposed to poor emotional regulation (Wang et al., 2004).
- Self-regulation develops rapidly in infancy and preschool years and is important to mental health and well-being throughout the lifespan (Rosanbalm & Murray, 2017). Woodward and colleagues found that poor self-regulation at preschool age predicted later development of ADHD, conduct disorder and anxiety (2017).
- While the literature suggests that some aspects of self-regulation develop prenatally, there are many ways to foster the development of self-regulation in infancy and early childhood (Harvard University, 2021).

Longer-term mental health implications

Research shows that childhood exposure to cannabis prenatally can affect mental health later in life. For example, in the OPPS cohort, prenatal cannabis exposure was associated with deficits in memory at a young age (Fried et al., 1980) and the deficits persisted into adulthood (Smith et al., 2006). As children aged, they continued to express increased hyperactivity, impulsivity and inattention (Goldschmidt et al., 2000; Goldschmidt et al., 2004; Gray et al., 2005;).

In adolescence, deficits in attention and related tasks continued to be problematic (Fried & Watkinson, 2000; Fried & Watkinson, 2001). Some studies also found higher rates of anxiety (Goldschmidt et al., 2004; Gray et al., 2005) and depressive symptoms in later childhood (Porath & Fried, 2005) as well as psychosis in adolescence and young adulthood (Day et al., 2015).

Putting this in context

- The bulk of the literature on longer-term mental health implications of prenatal cannabis exposure shows that behaviours apparent in infancy and young childhood continue to be present into later childhood and adolescence. This highlights the importance of early intervention.
- While it's important to examine infant and early childhood mental health, we know that it doesn't tell the whole story. Some mental health challenges may not appear until years later. Preliminary literature indicates that this could be the case with anxiety and depressive symptoms as well as psychosis.
- As this is outside the scope of our review, further exploration into the long-term impacts on mental health is recommended.

Studies finding no impact

Some studies have found that cannabis use has no effect on infant and early childhood mental health (Fried et al., 1992b; Richardson et al., 1995; Tennes et al., 1985). While this seems to contradict what is presented in this evidence summary, there are a few important caveats.

One is that the impact of in-utero cannabis exposure is dose-dependent. Since studies are largely observational, there is no way to control the dose and although some studies report on dose, this is prone to error (Thompson et al., 2019).

Second, the impact may not yet be apparent or be easily assessed at such a young age (Campolongo et al., 2008).

The third caveat is that these many of the studies finding no impact are decades old. Because of the known increase in potency of cannabis products over the years, these studies do not reflect the current context (Thompson et al., 2019).

On the other hand, we know that publication bias exists, whereby studies finding no impact are not published as readily as studies that do (Jajoo et al., 2012). Further research is needed.

Discussion

Studies examining the effect of prenatal or early postnatal cannabis exposure on infant and early childhood mental health are limited.

Historically, studies have focused on the impacts of cannabis use on cognitive development, but less so on mental health (Campolongo et al., 2008). Despite these limitations, there is some evidence of negative impacts on the mental health of infants and children. The literature points to withdrawal-like symptoms including startle response, tremors and irritability that resolve with time, increased externalizing behaviour, and deficits in executive functioning and self-regulation. These early behaviours may predict mental health challenges later in life.

The literature on this topic is far from conclusive.

Limitations of the literature include confounding variables, reliance on self-reporting, poor measurement of cannabis exposure and limited studies focusing on infant and early mental health. We know that people who report using cannabis during pregnancy typically have low socioeconomic status (Badowski & Smith, 2020; Ko et al., 2015) and a low level of education, and are likely to use other drugs or alcohol (Badowski & Smith, 2020; Grant et al., 2020; Ko et al., 2015). All these factors can have an impact on infant and early childhood mental health. Many studies, but not all, controlled for confounding variables.

When it comes to self-reporting, we know that drug use is commonly under-reported due to stigma, legality (depending on location of study) and social desirability bias (Groh et al., 2009). Some studies used additional methods to determine cannabis consumption, such as toxicology reports, but this practice was not widespread (De Moraes Barra et al., 2006). A related challenge is that different strains of cannabis and ways it is ingested result in varied potency, making it difficult to determine dose-related outcomes. A major limitation is the paucity of studies examining prenatal and early postnatal cannabis exposure on infant and early childhood mental health.

While prenatal cannabis exposure may predispose infants and children to certain mental health challenges, there are many ways in which adults can support children to strengthen skills (Harvard University, 2021). For example, there is a wealth of available literature on strategies to promote healthy self-regulation (Raver et al., 2011; Bierman et al., 2008; Razza et al., 2013).



To sum up

- Parental cannabis use during pregnancy or while nursing can result in early behaviours that predispose children to mental health challenges, such as depression and anxiety, later in life.
- There is a need for more high-quality, population-based, longitudinal studies examining the impacts of prenatal and early postnatal cannabis exposure on the mental health of infants and children. These studies should employ multiple methods to determine dose-related differences in outcomes. Studies should control for confounding variables such as social determinants of health and comorbid substance use.
- Findings as presented in this scan and from future high-quality research can be used to inform practice and support service providers in offering tailored supports for families affected by substance use.



References

- Badowski, S., & Smith, G. (2020). Cannabis use during pregnancy and postpartum. *Canadian Family Physician*, 66(2), 98-130. <https://www.cfp.ca/content/66/2/98>
- Bayrampour H., Zahradnik, M., Lisonkova, S., & Janssen, P. (2019). Women's perspectives about cannabis use during pregnancy and the postpartum period: An integrative review. *Preventative Medicine*, 119, 17-23. <https://doi.org/10.1016/j.ypmed.2018.12.002>
- Bierman, K.L., Domitrovich, C.E., Nix, R.L., Gest, S.D., Welsh, J.A., Greeberg, M.T., Blair, C., Nelse, K.E., & Gill, S. (2008). Promoting academic and social-emotional school readiness; The Head Start REDI Program. *Child Development*, 79(6), 1802-1817. <https://doi.org/10.1111/j.1467-8624.2008.01227.x>
- Broguera, P., Reynolds, J., Gilvarry, E., Braddick, F., Marath-Veettil, A.L., Anderson, P., Mielecka-Kubien, Z., Kaner, E., & Gual, A. (2018). How does economic recession affect substance use? A reality check with clients of drug treatment centres. *Journal of Mental Health Policy & Economics*, 21(1), 11-16. <https://pubmed.ncbi.nlm.nih.gov/29643264/>
- Calvigioni, D., Hurd, Y.L., Harkany, T., & Keimpema, E. (2014). Neuronal substrates and functional consequences of prenatal cannabis exposure. *European Child & Adolescent Psychiatry*, 23(10), 931-41. <https://doi.org/10.1007/s00787-014-0550-y>
- Carsley, S., & Leece, P. (2018, Nov). Evidence brief: Health effects of cannabis exposure in pregnancy and breastfeeding. Queen's Printer for Ontario. Ontario Agency Health Protection and Promotion (Public Health Ontario). Toronto, ON. <https://www.publichealthontario.ca/-/media/documents/E/2018/eb-cannabis-pregnancy-breastfeeding.pdf?la=en>
- Cohen, J., Oser, C., & Quigley, K. (2012). *Making it happen: Overcoming barriers to providing infant-early childhood mental health*. <https://www.zerotothree.org/resources/511-making-it-happen-overcoming-barriers-to-providing-infant-early-childhood-mental-health#downloads>
- Corsi, D.J., Hsu, H., Weiss, D., Fell, D.B., & Walker, M. (2019). Trends and correlates of cannabis use in pregnancy: a population-based study in Ontario, Canada from 2012-2017. *Canadian Journal of Public Health*, 110, 76-84. <https://doi.org/10.17269/s41997-018-0148-0>
- Daha, S.K., Sharma, P., Pankaj, K.S., Karn, A., & Poudel, A. (2020). Effects of prenatal cannabis use on fetal and neonatal development and its association with neuropsychiatric disorders: A systematic review. *Neurology, Psychiatric and Brain Research*, 38, 20-26. <https://doi.org/10.1016/j.npbr.2020.08.008>
- De Moraes Barros, M.C., Guinsberg, R., de Araujo Peres, C., Mitsuhiro, S., Chalem, E., & Laranjeira, R.R. (2006). Exposure to marijuana during pregnancy alters neurobehavior in the early neonatal period. *The Journal of Pediatrics*, 149 (6), 781-787. <https://doi.org/10.1016/j.jpeds.2006.08.046>
- El Marroun, H., Hudziak, J., Tiemeier, H., Creemers, H., Steegers, E., Jaddoe, V., Hoffman, A., Verhulst, F., Van Den Brink, W., & Huizink, A. (2011). Intrauterine cannabis exposure leads to more aggressive behaviour and attention problems in 18-month-old girls. *Drug and Alcohol Dependence*, 118(2-3), 470-474. <https://doi.org/10.1016/j.drugalcdep.2011.03.004>
- El Sohly, M. A., Mehmedic, Z., Foster, S., Gon, C., Chandra, S., & Church, J. C. (2016). Changes in Cannabis Potency Over the Last 2 Decades (1995-2014): Analysis of Current Data in the United States. *Biological Psychiatry*, 79(7), 613-619. <https://doi.org/10.1016/j.biopsych.2016.01.004>
- Fried, P.A. (1980). Marijuana use by pregnant women: neurobehavioral effects in neonates. *Drug and Alcohol Dependency*, 6(6), 415-424. [https://doi.org/10.1016/0376-8716\(80\)90023-X](https://doi.org/10.1016/0376-8716(80)90023-X)
- Fried, P.A., & Makin, J.E. (1987). Neonatal behavioral correlates of prenatal exposure to marijuana, cigarettes and alcohol in a low-risk population. *Neurotoxicology Teratology*, 9(1), 1-7. [https://doi.org/10.1016/0892-0362\(87\)90062-6](https://doi.org/10.1016/0892-0362(87)90062-6)



- Fried, P.A., Watkinson, B., & Dulberg, C.S. (1987). Neonatal neurological status in a low-risk population after prenatal exposure to cigarettes, marijuana, and alcohol. *Journal of Developmental Behavioral Pediatrics*, 8(6), 318-326. <https://pubmed.ncbi.nlm.nih.gov/3429670/>
- Fried P.A., & Watkinson B. (1990). 36- and 48-month neurobehavioral follow-up of children prenatally exposed to marijuana, cigarettes, and alcohol. *Developmental and Behavioral Pediatrics*, 11(2):49–58. <https://doi.org/10.1097/00004703-199004000-00003>
- Fried, P.A., Watkinson, B., & Gray, R. (1992a). A follow-up study of attentional behavior in 6-year-old children exposed prenatally to marihuana, cigarettes, and alcohol. *Neurotoxicology Teratology*, 14(5), 299-311. [https://doi.org/10.1016/0892-0362\(92\)90036-A](https://doi.org/10.1016/0892-0362(92)90036-A)
- Fried, P.A., O'Connell, C.M., & Watkinson, B. (1992b). 60- and 72- month follow-up of children prenatally exposed to marijuana, cigarettes, and alcohol: cognitive and language assessment. *Journal of Developmental Behavioural Pediatrics*, 13(6), 389-391. <https://doi.org/10.1097/00004703-199212000-00001>
- Fried, P.A., & Watkinson, B. (2000). Visuo-perceptual functioning differs in 9- to-12-year olds prenatally exposed to cigarettes and marihuana. *Neurotoxicology Teratology*, 22(1), 11-20. [https://doi.org/10.1016/S0892-0362\(99\)00046-X](https://doi.org/10.1016/S0892-0362(99)00046-X)
- Fried, P.A., & Watkinson, B. (2001). Differential effects on facets of attention in adolescents prenatally exposed to cigarettes and marihuana. *Neurotoxicology Teratology*, 23(5), 421-430. [https://doi.org/10.1016/S0892-0362\(01\)00160-X](https://doi.org/10.1016/S0892-0362(01)00160-X)
- Fried, P.A., & Smith, A.M. (2001). A literature review of the consequences of prenatal marihuana exposure: An emerging theme of a deficiency in aspects of executive function. *Neurotoxicology and Teratology*, 23(1), 1-11. [https://doi.org/10.1016/S0892-0362\(00\)00119-7](https://doi.org/10.1016/S0892-0362(00)00119-7)
- Goldschmidt, L., Day, N.L., & Richardson, G.A. (2000). Effects of prenatal marijuana exposure on child behaviour problems at age 10. *Neurotoxicology and Teratology*, 22(3), 325-336. [https://doi.org/10.1016/S0892-0362\(00\)00066-0](https://doi.org/10.1016/S0892-0362(00)00066-0)
- Goldschmidt, L., Richardson, G.A., Corenelius, M.D., & Day, N.L. (2004). Prenatal marijuana and alcohol exposure and academic achievement at age 10. *Neurotoxicology Teratology*, 26(4), 521-532. <https://doi.org/10.1016/j.ntt.2004.04.003>
- Goldschmidt, L., Richardson, G.A., Willford, J., & Day N.L. (2008). Prenatal marijuana exposure and intelligence test performance at age 6. *Journal of the American Academy of Child & Adolescent Psychiatry*, 47(3), 254-263. <https://doi.org/10.1097/CHI.0b013e318160b3f0>
- Government of Canada (2019, February 4). *Thinking about using cannabis before or during pregnancy?* <https://www.canada.ca/en/health-canada/services/drugs-medication/cannabis/health-effects/before-during-pregnancy.html>
- Government of Canada (2020, Dec 21). *Canadian cannabis survey 2020: Summary*. <https://www.canada.ca/en/health-canada/services/drugs-medication/cannabis/research-data/canadian-cannabis-survey-2020-summary.html>
- Gray, K.A., Day, N.L., Leech, S., Richardson, G.A. (2005). Prenatal marijuana exposure: effect on child depressive symptoms at ten years of age. *Neurotoxicology Teratology*, 27(3), 439-448. <http://dx.doi.org/10.1016/j.ntt.2005.03.010>
- Grinspoon, P. (2018) Medical marijuana. *Harvard Health Blog*. <https://www.health.harvard.edu/blog/medical-marijuana-2018011513085>
- Groh, D., Ferrari, J., & Jason, L. (2009). Self-reports of substance abusers: The relationship between social desirability and social network variables. *Journal of Groups in Addiction & Recovery*, 4(1-2), 51-61. <https://doi.org/10.1080/15560350802712397>



- Gunn, J.K., Rosales, C.B., Center, K.E., Nunez, K.E., Gibson, S.J., Christ, C., & Ehiri, J.E. (2016). Prenatal exposure to cannabis and maternal and child health outcomes: a systematic review and meta-analyses. *BMJ Open*, 6(25). <http://dx.doi.org/10.1136/bmjopen-2015-009986>
- Hall, W., Stejepanovic, D., Caulkins, J., Lynskey, M., Leung, J., Campbell, G., & Degenhardt, L. (2019). Public health implication of legalising the production and sale of cannabis for medicinal and recreational use. *The Lancet*, 394(10208), 580-1590. [https://doi.org/10.1016/S0140-6736\(19\)31789-1](https://doi.org/10.1016/S0140-6736(19)31789-1)
- Harvard University (2021). Executive function & self regulation. *Centre on the Developing Child*. <https://developingchild.harvard.edu/science/key-concepts/executive-function/>
- Hawley, P., Gobbo, M., & Afghari, N. (2020). The impact of legalization of access to recreational Cannabis on Canadian medical users with Cancer. *BMC Health Services Research*, 20(1), 977. <https://doi.org/10.1186/s12913-020-05756-8>
- The Hospital for Sick Children. (2009, Sept 10). *Neonatal abstinence syndrome*. About Kids Health. <https://www.aboutkidshealth.ca/Article?contentid=382&language=English>
- Jajooba, R., Schmitz, N., Annable, L., & Boksa, P. (2012). Publication bias: What are the challenges and can they be overcome? *Journal of Psychiatry Neuroscience*, 37(3), 149-152. <http://dx.doi.org/10.1503/jpn.120065>
- Jarlenski, M., Koma, J.W., Zank, J., Bodnar, L.B., Bogen, D.L., & Chang, J.C. (2017). Trends in perception of risk of regular marijuana use among US pregnant and nonpregnant reproductive-age women. *American Journal of Obstetrics and Gynecology*, 217(6), 705-707. <https://doi.org/10.1016/j.ajog.2017.08.015>
- Ko, J.Y., Farr, S.L., Tong, V.T., Creanga, A.A., & Callaghan, W.M. (2015). Prevalence and patterns of marijuana use amongst pregnant and nonpregnant women of reproductive age. *American Journal of Obstetrics and Gynecology*, 213(2), 201.e1-201.e2. <https://doi.org/10.1016/j.ajog.2015.03.021>
- Leyton, M. (2019). Cannabis legalization: Did we make a mistake? Update 2019. *Journal of Psychiatry & Neuroscience*, 44 (5), 291-293. <https://doi.org/10.1503/jpn.190136>
- Mazzucchelli, T.G., & Sanders, M.R. (2018). Children with externalizing behavior problems. In T.G. Mazzucchelli & M.R. Sanders (Eds.), *The power of positive parenting: Transforming the lives of children, parents, and communities using the Triple P system* (pp. 85-96). Oxford University Press. <http://dx.doi.org/10.1093/med-psych/9780190629069.003.0006>
- Otterman, D.L., Koopman-Verhoeff, M.E., White, T.J., Tiemeier, H., Bolhuis, K., & Jansen, P.W. (2019). Executive functioning and neurodevelopmental disorders in early childhood: A prospective population-based study. *Child Adolescent Psychiatry Mental Health*, 13(1), 38. <https://doi.org/10.1186/s13034-019-0299-7>
- Passey, M.E., Sanson-Fisher, R.W. D'Este, C.A., & Stirling, J.M. (2014). Tobacco, alcohol and cannabis use during pregnancy: Clustering of risks. *Drug and Alcohol Dependence*, 134(1), 44-50. <https://doi.org/10.1016/j.drugalcdep.2013.09.008>
- Paul, S.E., Hatout, A.S., Fine, J.D., Johnson, E.C., Hansen, I., Karcher, N.R., Moreau, A.L., Bondy, E., Qu, Y., Carter, E.B., Rogers, C.E., Agrawal, C.E., Barch, D.M., & Bodan, R. (2020). Associations between prenatal cannabis exposure and childhood outcomes: results from the ABCDE study. *JAMA Psychiatry*, 78(1), 64-76. [doi:10.1001/jamapsychiatry.2020.2902](https://doi.org/10.1001/jamapsychiatry.2020.2902)
- Porath, A.J. & Fried, P.A. (2005). Effects of prenatal cigarette and marijuana exposure on drug use among offspring. *Neurotoxicology and Teratology*, 27(2), 267-277. <https://doi.org/10.1016/j.ntt.2004.12.003>
- Raver, C.C., Jones, S.M., Li-Grining, C., Zhai, F., Bub, K., & Pressler, E. (2011). CCRP's impact on low-income preschoolers' preacademic skills: self-regulation as a mediating mechanism. *Child Development*, 82(1), 368-378. <https://doi.org/10.1111/j.1467-8624.2010.01561.x>

- Razza, R.A., Bergen-Cico, D., & Raymond, R.P. (2015). Enhancing preschoolers' self-regulation via mindful yoga. *Journal of Child and Family Studies*, 24(2), 372-385. <https://doi.org/10.1007/s10826-013-9847-6>
- Rosanbalm, K.D., & Murray, D.W. (2017). Promoting self-regulation in early childhood: a practical brief. OPRE Brief #2017-79. Washington, DC: Office of Planning, Research, and Evaluation, Administration for Children and Families, U.S. Department of Health and Human Services. <https://fpg.unc.edu/sites/fpg.unc.edu/files/resources/reports-and-policy-briefs/PromotingSelf-RegulationIntheFirstFiveYears.pdf>
- Rotermann, M. (2020). What has changed since cannabis was legalized? *Health Reports*. Statistics Canada. <https://www150.statcan.gc.ca/n1/en/pub/82-003-x/2020002/article/00002-eng.pdf?st=zGSu4TaA>
- Ryan, S.A., Ammerman, S.D., & O'Conner, M.E. (2018). Marijuana use during pregnancy and breastfeeding: Implications for Neonatal and childhood outcomes. *Official Journal of the American Academy of Pediatrics*, 142(3). <https://doi.org/10.1542/peds.2018-1889>
- Statistics Canada. (2021, Mar 4). *Alcohol and cannabis use during the pandemic: Canadian perspectives survey series 6*. Government of Canada. <https://www150.statcan.gc.ca/n1/daily-quotidien/210304/dq210304a-eng.htm>
- Stroud, L., Papandonatos, G.D., McCallum, M., Kehoe, T., Salisbury, A., & Huestis, M.A. (2018). Prenatal tobacco and marijuana co-use: Impact on newborn neurobehavior. *Neurotoxicology Teratology*, 70, 28-39. <https://doi.org/10.1016/j.ntt.2018.09.003>
- Tennes, K., Avitable, N., Blackard, C., Boyles, C., Hassoun, B., & Holmes, L. (1985). Marijuana : prenatal and post-natal exposure in the human. *National Institute on Drug Abuse, Monograph Series*, 59, 48-60. <https://pubmed.ncbi.nlm.nih.gov/3929132/>
- Thompson, R., DeJong, K., & Lo, J. (2019). Marijuana use in pregnancy: A review. *Obstetrics Gynecology Survey*, 74 (7). 415-428. <https://doi.org/10.1097/OGX.0000000000000685>
- United Nations Office on Drugs and Crime. (2020). *World drug report: Drug use and health consequences*. https://wdr.unodc.org/wdr2020/field/WDR20Booklet_2.pdf
- Wang X, et al. In utero marijuana exposure associated with abnormal amygdala dopamine D2 gene expression in the human fetus. *Biological Psychiatry*, 56 (12), 909-915. <https://doi.org/10.1016/j.biopsych.2004.10.015>
- Westfall, R.E., Janssen, P.A., Lucas, P., & Capler, R. (2006). Survey of medical cannabis use among childbearing women: patterns of its use in pregnancy and retroactive self-assessment of its efficacy against 'morning sickness'. *Complementary therapies in Clinical Practice*, 12(1), 27-33. <https://doi.org/10.1016/j.ctcp.2005.09.006>
- Woodward, L.J., Lu, Z., Morris, A.R., & Healey, D.M. (2017). Preschool self regulation predicts later mental health and educational achievement in very preterm and typically developing children. *Clinical Neuropsychology*, 31(20), 404-422. <https://dx.doi.org/10.1080/13854046.2016.1251614>
- Zawilska, J.B., & Wojcieszak, J. (2014). Spice/ K2 drugs--more than innocent substitutes for marijuana. *International Journal of Neuropsychopharmacology*, 17(3), 509-525. <https://doi.org/10.1017/S1461145713001247>

 613-737-2297

 613-738-4894

 cymh.ca (EN)
smea.ca (FR)

 [cymhon](https://www.linkedin.com/company/cymhon)

 [@CYMH_ON](https://twitter.com/CYMH_ON)

 [CYMHOntario](https://www.facebook.com/CYMHOntario)



**695 Industrial Avenue, Ottawa Ontario
Canada K1G 0Z1**



Ontario Centre of Excellence
for Child & Youth Mental Health
Centre d'excellence de l'Ontario en santé
mentale des enfants et des adolescents