

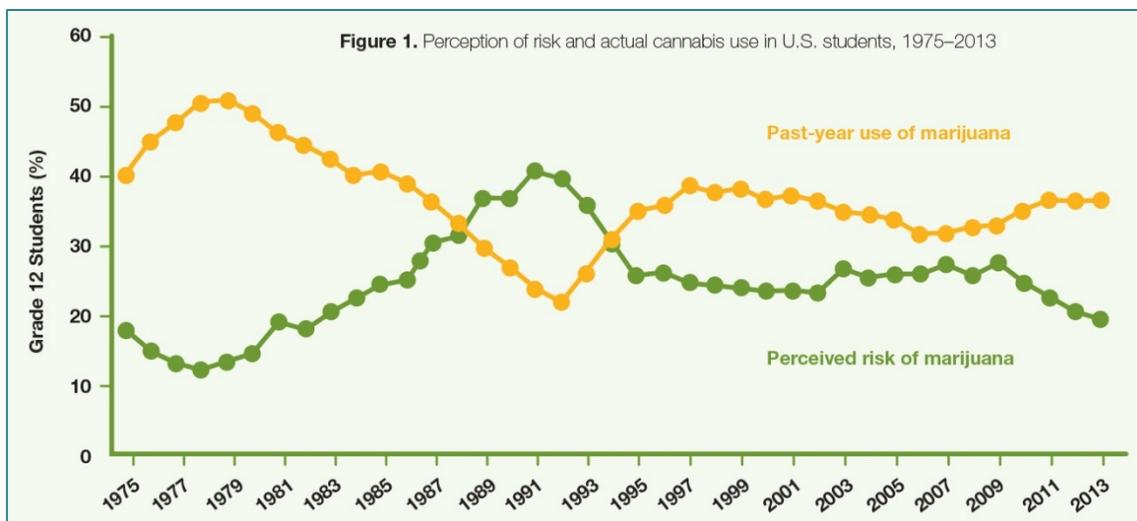


The Effects of Cannabis Use during Adolescence

The Issue

Cannabis use, a prominent political, health and law enforcement issue in Canada, is currently receiving a great deal of attention. Policy developments in different parts of the world and ongoing public debate in Canada may be influencing the views held by youth about the drug. They are especially vulnerable to the negative effects of cannabis use, since the adolescent brain undergoes rapid and extensive development until a person reaches his or her mid-twenties. Brain development during this time helps to lay the foundation for success or, conversely, challenges later in life.

About one quarter of Canadian youth aged 15–24 reported using cannabis in 2013, making it the most commonly used illegal drug among this age group.¹ Of great concern is the 27.4% of youth who used cannabis daily or almost daily during the past three months.¹ Youth may not be concerned about this pattern of use as many view cannabis to be natural, safe and not addictive.² Indeed, research has noted that youth who do not think using cannabis presents risks are more likely to report using the drug (see Figure 1).³ In fact, some youth have said that using cannabis could enhance their focus while driving, improve their health and even prevent or cure cancer.²



Purpose of this Report in Short

This report in short summarizes the research evidence on the health, psychological and social effects of adolescent cannabis use that is covered more comprehensively in the technical report on which it is based.* It focuses on youth who use cannabis daily or almost daily, as this is the age group in which severe and potentially irreversible effects that can seriously limit future success can

* *The Effects of Cannabis Use during Adolescence* is part of the *Substance Abuse in Canada* series, which covers key substance abuse issues and highlights areas for action in both policy and practice. All volumes in the series are available on the CCSA website.



be observed. This report cuts through the abundance of information circulating about cannabis from various perspectives to clearly identify what we know, what we do not yet know and what evidence is emerging about the effects of cannabis use during adolescence.

The evidence reviewed in the report supports efforts to reduce harm to youth by decreasing the number who use cannabis or delaying the start of use for those who choose to use it. By situating the relevant neuroscience in the broader behavioural and social contexts of youth cannabis use, the report provides a much-needed resource for developing youth policies, programs and practices related to cannabis. Finally, the report identifies areas where future studies are needed to clarify the relationships between cannabis use and outcomes for youth to reduce cannabis-related harms.

Cannabis Impacts the Brain

Humans are born with an endocannabinoid system that responds to chemicals (cannabinoids) that are developed in the brain and that are similar to the psychoactive components of cannabis.⁴ The endocannabinoid system aids the extensive brain development that occurs during youth, regulating activity and communication in the brain and affecting memory, learning, coordination, appetite, pain, mood, pleasure and motivation.⁴⁻⁶ **Consuming cannabis regularly during adolescence interferes with the function and development of this brain system.**^{7,8} As a result, youth who use cannabis regularly are at risk for harmful effects on their mental health and cognitive functioning, as well as for developing cannabis dependence, which are discussed in more detail in the following sections.

Cannabis Use Negatively Affects Cognition and Behaviour

Accumulating research indicates that **regular cannabis use initiated early in life can result in behavioural and cognitive impairments**, including poor academic performance, and deficits in attention, information processing and memory.⁹⁻¹⁹ These deficits have been shown to persist after an individual stops using cannabis;¹³ however, **the exact duration of impairment is still unknown.**

Brain imaging of adolescents who used cannabis has revealed differences in the size (both increases and decreases),²⁰⁻³¹ connectivity^{32,33} and quality^{9,26,34-38} of various brain structures, as compared to non-users. The earlier that individuals started regular use, the more impaired the nerve connections were in the brain,³⁸ and in those who began using cannabis at a later age some of these negative effects were not seen.²⁶ It remains unclear as to whether these differences were the result of cannabis use, or if they were present before a youth began using cannabis and might have been a motivating factor for use. Still, the findings are significant as they represent a brain that is not as efficient or healthy as it could be.

When looking at brain function, imaging of the brains of youth who use cannabis showed greater activity while completing tasks, as compared to those who did not use cannabis.^{12,17,18} This increased activity indicates the brain was working harder to perform a task and used more resources to respond. In these cases, the brain may have been compensating for structural changes, which can lead to fatigue over time and might ultimately result in cognitive efficiency problems.¹⁸ These differences were observed in brain regions critical for executive functioning (e.g., planning and decision making, and establishing and completing goals), which are necessary for future success.

Similarly, the apathy that can be observed among youth who use cannabis³⁹ might be related to a reduction of volume in the front of the brain,²⁴ which acts as a network hub for many behaviours involved in reward processing, motivation, self-awareness and decision making, and that also has a great quantity of cannabinoid receptors. This front portion is one of the latest brain regions to complete development and so is particularly vulnerable to the disruptive effects of cannabis use during this period when it is not fully formed. These negative effects appear to be related to early



onset and chronic use. Thus, **delaying the age of use onset might protect the brain**, as there are fewer cannabinoid receptors present in the mature brain than in the developing brain.³⁸

Cannabis Impairs Driving Abilities

Cannabis can produce deficits in attentional focus, information processing, motor coordination and reaction time, making it unsafe to operate a motor vehicle while impaired.¹¹ People who drive under the influence of cannabis are at a significantly increased risk of motor vehicle collisions compared to drivers who have not used cannabis, alcohol or other drugs.^{40,41} This risk is further increased when cannabis is consumed together with alcohol.¹¹ Drivers who use cannabis have been shown to attempt to compensate by driving slower, but have reduced control when more complex tasks are involved. This impairment results in more lane weaving, slower reaction times, difficulties paying attention to multiple things at once, and flawed eye–hand coordination and reaction times.^{42–45}

Cannabis is Linked to Mental Health Concerns

It is well established that **regular cannabis use is associated with experiencing psychotic symptoms and developing schizophrenia**, especially among those who have a personal or family history of psychotic disorders.^{46–50} Whether drug use induces psychosis and schizophrenia, or whether these illnesses put people at risk for drug use is still unknown.

The connections between cannabis use and other mental illnesses, especially anxiety, are less clear. Some studies have found that regular cannabis use by adolescents is associated with an increased risk of depression,^{51,52} worsening symptoms of depression, anxiety⁵³ and bipolar disorder,^{54–57} suicidal thoughts and attempts,⁵⁸ eating disorders,⁵⁹ and childhood disorders.⁶⁰

It was once thought that adolescents with anxiety and mood disorders self-medicated with cannabis to improve their symptoms.^{61,62} However, longitudinal studies have found that this theory does not account for the pattern of cannabis use among adolescents and young adults with depression, anxiety or bipolar disorder.^{53,63} Nonetheless, social anxiety and post-traumatic stress disorder are risks for the onset of problematic cannabis use among adolescents and young adults,^{64,65} as people living with these conditions may use cannabis for its anxiety-inhibiting properties.⁶⁶ Indeed, some studies have shown that activation of the endocannabinoid system can reduce symptoms of anxiety.^{67,68} There is a complex relationship between cannabis and anxiety such that anxiety may either be enhanced or reduced after use of cannabis. Further research, taking into account biological and environmental factors, is needed to achieve a better understanding of this relationship.

Regardless of which occurs first, symptoms of mental illness or cannabis use, the detrimental effects of consuming cannabis could be related to malfunctioning of the cannabinoid system in the brain. A gene might make individuals vulnerable to both cannabis use and developing schizophrenia,^{69,70} or might interact with early cannabis exposure to increase the risk of developing schizophrenia or psychosis.^{71,72} Alternatively, cannabis might lead to dysregulation of the body's stress response system, which has implications for developing mood and anxiety disorders.⁷³ **Further research is needed to completely understand the interrelations between genes, experiences and poor outcomes.**⁷⁴

Cannabis Can Be Addictive

It is estimated that **one in six individuals who use cannabis during adolescence will develop a cannabis use disorder**,⁷⁵ defined as a problematic pattern of cannabis use leading to clinically significant impairment or distress.⁷⁶ (See the technical report for additional diagnostic criteria.) Compared to alcohol and tobacco, cannabis use can develop more quickly into a substance use disorder among adolescents.⁷⁷ Problems are typically observed among “heavy users” or those who use daily or almost



daily.¹¹ More than one in 20 Canadians ages 15–24 met the criteria for cannabis abuse or dependence in 2012.⁷⁸ **Among those with a cannabis use disorder, withdrawal can occur**, with individuals experiencing irritability, anxiety, restlessness, appetite changes and sleep disturbances.⁷⁹

How can we recognize who will develop dependence? The influence of genes might contribute to how an individual responds to their first exposure to cannabis, **yet the exact genes and the pathways through which they exert their influences are still unclear**. Genes may account for 51–59% of determining problematic cannabis use, whereas shared environments, such as being raised in the same household, account for 15–20%, and unshared environments, such as having different peer groups, account for 26–29%, depending on gender.⁸⁰ Psychosocial factors found to contribute to risk of cannabis dependence were early initiation (by age 15), low socioeconomic status, use of other drugs, male gender, regular cannabis use, anti-social behaviour, persistent tobacco use, living alone, using cannabis as a coping mechanism, and number and type of recent negative life events.^{81–84}

Though studies have shown that cannabis use can be associated with an increased risk of using other illegal drugs,^{85,86} there are many factors influencing an individual's drug use trajectory. It might be that risk factors for using additional drugs are the same factors that led an individual to use cannabis in the first place, as opposed to cannabis being the cause of subsequent drug use.

Interventions for Problematic Cannabis Use

Given the findings that cannabis use is related to negative effects on multiple aspects of a youth's life, the importance of prevention, early identification and intervention cannot be overstated. The best preventive education programs delivered in schools or healthcare facilities can delay initiation of use by 20–40% compared to the outcome in groups not exposed to such programs. Primary healthcare providers are optimally placed to screen for all substance use concerns when interacting with young patients. Among those who indicate potentially problematic behaviour, brief motivational interviewing, a type of counselling that prepares people to change their behaviours,⁸⁷ has resulted in improvements in cannabis-related measures as compared to those in control conditions.^{88–90}

Healthcare providers must recognize when the severity of a youth's cannabis use exceeds their expertise, and when to refer a patient to specialized treatment. **Specialized treatments have mainly involved therapies focused on psychological well-being, such as cognitive behavioural therapy (CBT), motivational enhancement therapy (MET), and multidimensional family therapy (MDFT), all of which have resulted in reductions in cannabis use among youth.**^{91–94} Contingency management (CM), where participants receive a reward if they meet pre-established criteria such as drug abstinence,⁹⁵ has resulted in improvements in treatment retention and cannabis-free urine samples;⁹⁶ though the results are mixed as to whether CM can enhance other therapeutic interventions.⁹⁷

There are also medications that can diminish withdrawal symptoms, but have not yet demonstrated improved clinical outcomes, nor were they tested primarily among adolescents.^{98–101} Similarly, one drug, N-acetylcysteine, has shown promise in reducing cannabis craving and use among youth aged 18–21 years old,¹⁰² and has proven even more effective when combined with brief counselling and CM,¹⁰³ but clinical trials of this medication are still needed.

Emerging research has outlined the **potential of novel areas for treatment, including mobile technology, internet and computer-based interventions**. These have shown promise as they are accessible and might meet youth's needs for immediate support in high-risk situations.^{104,105}



Call to Action

The evidence summarized in this report indicates that cannabis is not a harmless drug. The negative effects of regular use by the large percentage of youth, combined with misperceptions of this drug, have the potential to impact society as a whole, as youth represent the future of our country. We have a strong knowledge base about the risks and harms associated with cannabis use, and we can use this information to inform effective programs, policy and practice.

The knowledge in this report can inform prevention programs that need to be comprehensive, factual and multi-faceted to be effective. These programs should involve family members, schools and the community, and speak to youth about their misperceptions of cannabis being a benign substance. The findings reveal that the youth brain might be particularly vulnerable to the effects of cannabis, and thus education and prevention programs that encourage delaying cannabis use could be paramount.

Healthcare providers are well placed to identify and intervene early when cannabis use concerns are observed. The development of a youth-focused screening tool for cannabis use may be beneficial to increase the capacity of frontline clinicians to identify youth in need of help, and to provide an entryway into educating youth about the harmful effects of cannabis use.

Similarly, youth need to know the potentially fatal dangers of driving after using cannabis. Greater education and public awareness of this issue is critical. The development and implementation of improved roadside screening for cannabis is needed to begin to address these acute harms.

Continuing to learn about factors leading to initiation, patterns and impacts of use, to concretely identify cause and effects of use will provide a clearer picture of where to focus prevention and treatment efforts. An opportunity exists to develop pilot programs using the evidence within this report, including comparing longer-term interventions against brief, technology-based or assisted interventions. Investments in young people, such as these research studies and others listed in the technical report, can yield long-term improvements in health and socioeconomic outcomes for individuals and families.

Additional Resources

- The Effects of Cannabis Use during Adolescence
- Clearing the Smoke on Cannabis Series
- Canadian Drug Summary: Cannabis
- Marijuana for Non-Therapeutic Purposes: Policy Brief
- Marijuana for Non-Therapeutic Purposes: Policy Considerations
- What Canadian Youth Think About Cannabis

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The Canadian Centre on Substance Abuse changes lives by bringing people and knowledge together to reduce the harm of alcohol and other drugs on society. We partner with public, private and non-governmental organizations to improve the health and safety of Canadians.

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- ¹ Analysis based on the Statistics Canada 2013 Canadian Tobacco, Alcohol and Drugs Survey. Computation and interpretation of these data are entirely that of the Canadian Centre on Substance Abuse.
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