

# Marijuana - How Safe is it Really?

B. Falk-Dotan

Integrated Science, McMaster University

## Summary

In light of recent political controversy regarding its legalization and regulation, the safety and health-related effects of marijuana have gained relevance in Canada. The known acute adverse effects, long-term adverse effects, and medicinal effects of marijuana are assessed and compared alcoholic beverages and tobacco cigarettes. Marijuana appears to have acute effects comparable to alcohol, relatively mild long-term effects, and some medically applicable effects. None of the three substances examined appears to be healthy if used regularly.

Received: 01/04/2016 Accepted: 02/16/2016 Published: 02/16/2016

URL: <https://journals.mcmaster.ca/iScientist/article/view/1104/991>

**Keywords:** Cannabis, marijuana, safety, health, tobacco, alcohol

One of the most controversial promises made by Prime Minister Justin Trudeau has been the legalization of marijuana. Trudeau and his party have promised to “legalize, regulate, and restrict access to marijuana” (Liberal Party of Canada, 2015), which could lead to marijuana being vended at Liquor Control Board of Ontario (LCBO) locations (Canadian Broadcasting Corporation, 2015). Like former Prime Minister Stephen Harper, current opposition leader Rona Ambrose insists that this is the wrong move. Ambrose cites health and safety concerns, especially for children (Lunn, 2015). The final policy decision should be based on a variety of factors beyond the scope of this publication, but in this article I review some of the known acute and chronic effects of smoking marijuana and evaluate their severity in relation to alcoholic beverages and tobacco cigarettes, popular substances that are legal but closely regulated in Canada.

## Botany of *Cannabis*

*Cannabis* is a genus of dioecious flowering plant, consisting of three species and multiple subspecies. *Cannabis* plants are exceptionally fast growers, growing 5 cm in a day under the appropriate conditions, and up to a height of 6 metres. *Cannabis* is thus widely used for the production of fibres (known as hemp fibres). Some varieties, particularly *C. indica* and *C. sativa*, also produce pharmacologically significant amounts of  $\Delta^9$ -tetrahydrocannabinol (THC; Craker and Gardner, 2010). In the brain, THC binds to the CB<sub>1</sub> cannabinoid

receptor (a G-protein coupled receptor). This ultimately gives rise to the characteristic psychoactive effects of marijuana: euphoria, sedation, altered perception, analgesia, anti-emesis, appetite stimulation, and effects on motor function (Elphick and Egertová, 2001). Although marijuana is often used as a recreational drug for its euphoria, it is also used medicinally for its analgesic, antiemetic, and appetite-stimulating effects.

## Acute Adverse Effects

Under the acute influence of marijuana, various psychological effects can impair judgement. Thus, the acute effects of THC are relevant to the safety of marijuana use. The psychoactive effects of marijuana smoking are immediate, and peak about 30 minutes after smoking (Crean, Crane and Mason, 2011). This is approximately the same time as required for alcohol concentrations to peak (Sutker et al., 1983). Among infrequent users, inhalation of marijuana smoke impairs attention and concentration. However, among frequent marijuana smokers, marijuana intoxication actually improves attention and concentration, suggesting that the effects of marijuana on attention and concentration is mediated by neurobiological adaptations in the brain (Crean, Crane and Mason, 2011). The same cannot be said for alcohol, which impairs attention even in frequent users (Howland et al., 2011). THC intoxication (Crean, Crane and Mason, 2011) and alcohol intoxication (MacDonald, Zanna and Fong, 1995) both impair decision-making latency and

accuracy, suggesting that either substance could impair users so that they are unable to safely drive a motor vehicle. THC also impairs the abilities to encode, consolidate, and retrieve short-term memories (Ranganathan and D'Souza, 2006). Although the mechanism differs, this is comparable to the amnesia that commonly results from alcohol intoxication (Goodwin et al., 1970). Thus, the acute effects of marijuana smoking (and THC in particular) are comparable to drinking alcohol, and seemingly less severe.

### **Long-Term Adverse Effects**

However, much discussion has also surrounded the long-term effects of marijuana use, especially on children. No clinical trials have yet established that marijuana use causes dependence by a physiological or biochemical mechanism, but unfortunately psychological dependence on marijuana exists and is most prevalent among adolescents (Kandel et al., 1997). However, the rate of marijuana dependence seems to be similar to alcohol dependence and much lower than tobacco dependence (Kandel et al., 1997). Unlike marijuana, well-designed studies have found specific mechanisms for tobacco dependence (Benowitz, 2008) and alcohol dependence (Herz, 1997). Like tobacco, marijuana is typically administered through inhalation of smoke. Smoking can reduce the pulmonary alveolar macrophage population, and may have other immunological effects (Holt and Keast, 1977). The effects of tobacco smoking are well-documented, including increased cancer risk (Hecht, 1999), ischemic heart disease (Law, Morris and Wald, 1997), and other cardiopulmonary conditions. There is some indication that marijuana smoke can have negative pulmonary effects (Fligiel, 1997), but it appears that, in moderation, marijuana use has little or no adverse pulmonary effects, whereas tobacco does (Pletcher et al., 2012). Chronic marijuana smoking may also reduce decision-making abilities (Verdejo-Garcia et al., 2007), likely due to decreased activity in the prefrontal cortex (Hester, Nestor and Garavan, 2009). Further, smoking marijuana during the first or second trimester of pregnancy is associated with decreased intelligence at age three (Day et al., 1994). Interestingly, some studies have failed to find an

increase in mortality due to marijuana use (Sidney et al., 1997; Andréasson and Allebeck, 1990).

### **Medically Useful Effects**

Unlike alcohol and tobacco, marijuana is sometimes prescribed for medicinal purposes. For example, the THC in marijuana has a potent analgesic effect and does not need to be injected. In treating postoperative pain, marijuana has a similar effect to common orally-administered analgesics, without frequent adverse effects (Holdcroft et al., 2006). Marijuana is also a potent anti-emetic. In chemotherapy patients, cannabinoids are more potent at reducing nausea and vomiting than conventional anti-emetic drugs. Although cannabinoids more frequently produced side effects, patients typically prefer them to conventional anti-emetics (Tramèr et al., 2001). Marijuana is also used to stimulate weight gain in medicinal contexts. THC in marijuana can cause increased appetite and weight gain (Foltin, Fischman and Byrne, 1988; Berry and Mechoulam, 2002). Additionally, the THC in marijuana has a sedative effect (Block, 1998). Although sedation can impair patient's cognitive abilities, sedative drugs are often useful for reducing the anxiety associated with some invasive medical procedures. In some cases, marijuana can serve a double purpose, as both an analgesic and a sedative, making it a potentially attractive alternative to methods involving separate analgesic and sedative drugs. Marijuana is thus a medically useful substance, in contrast with alcohol and tobacco.

### **Conclusion**

Like alcohol and tobacco, marijuana can have serious undesirable side-effects but, unlike alcohol and tobacco, marijuana can also have useful effects. The acute adverse effects of marijuana smoking, while qualitatively different, seem comparable to alcohol in the safety risks that may be associated with their use. Chronic marijuana use can effect addiction, but seemingly not more so than alcohol or tobacco use. Chronic marijuana use may also have adverse immune or cardiopulmonary effects, but they appear to be minimal in contrast with the adverse effects of tobacco use. Chronic exposure to marijuana may also have adverse cognitive effects. Unlike alcohol and

tobacco, marijuana can be useful in some medical applications, including analgesia, anti-emesis, appetite control, and anti-anxiety (sedation).

Marijuana smoking, tobacco smoking, and alcohol drinking can all have serious long-term health effects if consumed in excess. However, it appears that none produce desirable long-term effects. Thus, while occasional consumption may not be harmful, regular consumption in substantial volumes of marijuana, tobacco, or alcohol is likely to produce adverse health effects and should be avoided.

## References

- Andréasson, S., and Allebeck, P., 1990. Cannabis and mortality among young men: a longitudinal study of Swedish conscripts. *Scandinavian journal of social medicine*, 18(1), pp.9–15.
- Benowitz, N., 2008. Clinical Pharmacology of Nicotine: Implications for Understanding, Preventing, and Treating Tobacco Addiction. *Clinical Pharmacology & Therapeutics*, 83(4), pp.531–541.
- Berry, E.M., and Mechoulam, R., 2002. Tetrahydrocannabinol and endocannabinoids in feeding and appetite. *Pharmacology & Therapeutics*, 95(2), pp.185–190.
- Block, R., 1998. Sedative, Stimulant, and Other Subjective Effects of Marijuana: Relationships to Smoking Techniques. *Pharmacology Biochemistry and Behavior*, 59(2), pp.405–412.
- Canadian Broadcasting Corporation, 2015. *LCBO well suited to sell marijuana when legal, Kathleen Wynne says*. [online] CBC News. Available at: <<http://www.cbc.ca/news/canada/toronto/wynne-marijuana-lcbo-1.3364158>> [Accessed 25 Dec. 2015].
- Craker, L.E., and Gardner, Z., 2010. The Botany of Cannabis. In: J. Holland, ed., *The Pot Book: A Complete Guide to Cannabis*. Toronto, ON: Inner Traditions / Bear & Co, pp.35–43.
- Crean, R.D., Crane, N.A., and Mason, B.J., 2011. An evidence based review of acute and long-term effects of cannabis use on executive cognitive functions. *Journal of addiction medicine*, 5(1), pp.1–8.
- Day, N.L., Richardson, G.A., Goldschmidt, L., Robles, N., Taylor, P.M., Stoffer, D.S., Cornelius, M.D., and Geva, D., 1994. Effect of prenatal marijuana exposure on the cognitive development of offspring at age three. *Neurotoxicology and Teratology*, 16(2), pp.169–175.
- Elphick, M.R., and Egertová, M., 2001. The neurobiology and evolution of cannabinoid signalling. *Philosophical transactions of the Royal Society of London. Series B, Biological sciences*, 356(1407), pp.381–408.
- Fligiel, S.E.G., 1997. Tracheobronchial Histopathology in Habitual Smokers of Cocaine, Marijuana, and/or Tobacco. *CHEST Journal*, 112(2), p.319.
- Foltin, R.W., Fischman, M.W., and Byrne, M.F., 1988. Effects of smoked marijuana on food intake and body weight of humans living in a residential laboratory. *Appetite*, 11(1), pp.1–14.
- Goodwin, D.W., Othmer, E., Halikas, J.A., and Freemon, F., 1970. Loss of Short Term Memory as a Predictor of the Alcoholic 'Blackout'. *Nature*, 227(5254), pp.201–202.
- Hecht, S.S., 1999. Tobacco Smoke Carcinogens and Lung Cancer. *JNCI Journal of the National Cancer Institute*, 91(14), pp.1194–1210.
- Herz, A., 1997. Endogenous opioid systems and alcohol addiction. *Psychopharmacology*, 129(2), pp.99–111.
- Hester, R., Nestor, L., and Garavan, H., 2009. Impaired error awareness and anterior cingulate cortex hypoactivity in chronic cannabis users. *Neuropsychopharmacology: official publication of the American College of Neuropsychopharmacology*, 34(11), pp.2450–8.
- Holdcroft, A., Maze, M., Dore, C., Tebbs, S., and Thompson, S., 2006. A Multicenter Dose-escalation Study of the Analgesic and Adverse Effects of an Oral Cannabis Extract (Cannador) for Postoperative Pain Management. *Anesthesiology*, 104(5), pp.1040–1046.
- Holt, P.G., and Keast, D., 1977. Environmentally induced changes in immunological function: acute and chronic effects of inhalation of tobacco smoke and other atmospheric contaminants in man and experimental animals. *Bacteriological reviews*, 41(1), pp.205–16.
- Howland, J., Rohsenow, D.J., Arnedt, J.T., Bliss, C.A., Hunt, S.K., Calise, T.V., Heeren, T., Winter, M., Littlefield, C., and Gottlieb, D.J., 2011. The acute effects of caffeinated versus non-caffeinated alcoholic beverage on driving performance and attention/reaction time. *Addiction*, 106(2), pp.335–341.
- Kandel, D., Chen, K., Warner, L.A., Kessler, R.C., and Grant, B., 1997. Prevalence and demographic correlates of symptoms of last year dependence on alcohol, nicotine, marijuana and cocaine in the U.S. population. *Drug and Alcohol Dependence*, 44(1), pp.11–29.
- Law, M.R., Morris, J.K., and Wald, N.J., 1997. Environmental tobacco smoke exposure and ischaemic heart disease: an evaluation of the evidence. *BMJ*, 315(7114), pp.973–980.
- Liberal Party of Canada, 2015. *Marijuana*. [online] Liberal.ca. Available at: <<https://www.liberal.ca/realchange/marijuana/>> [Accessed 24 Dec. 2015].
- Lunn, S., 2015. *Liquor stores not place to sell pot, says Rona Ambrose*. [online] CBC News. Available at: <<http://www.cbc.ca/news/politics/marijuana-sales-liquor-stores-lcbo-1.3365181>> [Accessed 24 Dec. 2015].
- MacDonald, T.K., Zanna, M.P., and Fong, G.T., 1995. Decision making in altered states: Effects of alcohol on attitudes toward drinking and driving. *Journal of Personality and Social Psychology*, 68(6), pp.973–985.
- Pletcher, M.J., Vittinghoff, E., Kalhan, R., Richman, J., Safford, M., Sidney, S., Lin, F., and Kertesz, S., 2012. Association between marijuana exposure and pulmonary function over 20 years. *JAMA*, 307(2), pp.173–81.
- Ranganathan, M., and D'Souza, D.C., 2006. The acute effects of cannabinoids on memory in humans: a review. *Psychopharmacology*, 188(4), pp.425–44.
- Sidney, S., Beck, J.E., Tekawa, I.S., Quesenberry, C.P., and Friedman, G.D., 1997. Marijuana use and mortality. *American journal of public health*, 87(4), pp.585–90.

Sutker, P.B., Tabakoff, B., Goist, K.C., and Randall, C.L., 1983. Acute alcohol intoxication, mood states and alcohol metabolism in women and men. *Pharmacology Biochemistry and Behavior*, 18, pp.349–354.

Tramèr, M.R., Carroll, D., Campbell, F.A., Reynolds, D.J., Moore, R.A., and McQuay, H.J., 2001. Cannabinoids for control of chemotherapy induced nausea and vomiting: quantitative systematic review. *BMJ (Clinical research ed.)*, 323(7303), pp.16–21.

Verdejo-Garcia, A., Benbrook, A., Funderburk, F., David, P., Cadet, J.-L., and Bolla, K.I., 2007. The differential relationship between cocaine use and marijuana use on decision-making performance over repeat testing with the Iowa Gambling Task. *Drug and Alcohol Dependence*, 90(1), pp.2–11.