




## Are vaporizers a lower-risk alternative to smoking cannabis?

Michael Chaiton<sup>1,2,3</sup> · Anasua Kundu<sup>1</sup> · Sergio Rueda<sup>2,3,4</sup> · Patricia Di Ciano<sup>2,3,5</sup> 

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### Abstract

Cannabis use is associated with various adverse physical and mental health outcomes as well as increased risk of motor vehicle collision. Many organizations and the “Lower-Risk Cannabis Use Guidelines” have recommended to use cannabis vaporizers instead of smoking to reduce the associated health risk. This commentary draws attention to the present evidence regarding harm reduction potential of cannabis vaping. Cannabis vaporizer use can reduce the emission of carbon monoxide, chronic respiratory symptoms, and exposure to several toxins while producing similar subjective effects and blood THC concentration compared with smoking cannabis, holding potential for harm reduction among habitual cannabis smokers. However, new cannabis users, regardless of method of administration of cannabis, may experience intense subjective effects and cognitive impairment with increased susceptibility to dependence. Hence, policy makers should consider limiting access to cannabis among young people and adopting strategies to reduce impaired driving under influence of cannabis. Future research should focus on impact of switching from cannabis smoking to dried herb vaping using cannabis vaporizers among chronic cannabis smokers, and long-term outcomes of medical cannabis vaping, and further explore association of vaping-associated lung injury with THC-containing e-liquids.

### Résumé

L'usage du cannabis est associé à une panoplie de résultats de santé physique et mentale indésirables et à un risque accru de collision entre véhicules automobiles. De nombreux organismes, ainsi que les « Recommandations canadiennes pour l'usage du cannabis à moindre risque », recommandent d'utiliser un vaporisateur au lieu de fumer le cannabis afin d'en réduire les risques pour la santé. Notre commentaire attire l'attention sur les preuves actuelles concernant le potentiel de réduction des méfaits du vapotage du cannabis. L'utilisation d'un vaporisateur de cannabis peut réduire l'émission de monoxyde de carbone, les symptômes respiratoires chroniques et l'exposition à plusieurs toxines tout en produisant des effets subjectifs et une concentration de THC dans le sang semblables à ceux du cannabis fumé, ce qui pourrait réduire les méfaits chez les fumeurs réguliers de cannabis. Par contre, les nouveaux consommateurs de cannabis, peu importe la méthode d'administration du cannabis choisie, peuvent éprouver des effets subjectifs intenses et une détérioration cognitive, ainsi qu'une susceptibilité accrue à la dépendance. Les responsables des politiques devraient donc songer à limiter l'accès des jeunes au cannabis et adopter des stratégies pour réduire la conduite avec facultés affaiblies par cette drogue. Des études futures devraient porter sur les conséquences, pour les fumeurs réguliers de cannabis, de vapoter l'herbe séchée à l'aide d'un vaporisateur au lieu de fumer le cannabis, et sur les effets à long terme du vapotage du cannabis médical, et explorer plus avant l'association entre les lésions pulmonaires associées au vapotage et les liquides à vapoter contenant du THC.

**Keywords** Cannabis; Smoking; Vaporizers; Vaping; Harm reduction

**Mots-clés** Cannabis; tabagisme; vaporisateurs; vapotage; réduction des méfaits

✉ Michael Chaiton  
michael.chaiton@camh.ca

<sup>1</sup> Dalla Lana School of Public Health, University of Toronto, Toronto, ON, Canada

<sup>2</sup> Ontario Tobacco Research Unit, Centre for Addiction and Mental Health, 155 College St., Toronto, ON M5T 3M7, Canada

<sup>3</sup> Campbell Family Mental Health Research Institute, Toronto, ON, Canada

<sup>4</sup> Department of Psychiatry, University of Toronto, Toronto, ON, Canada

<sup>5</sup> Department of Pharmacology and Toxicology, University of Toronto, Toronto, ON, Canada

## Introduction

In October 2018, Canada became the second country to legalize cannabis at the federal level for recreational use under the “Cannabis Act”. There are various forms of cannabis products available both on the legal and illicit market, such as dried flowers or leaf, cannabis oil, chemically concentrated extracts (butane hash oil, wax, shatter, budder), physically concentrated extracts (hash or kief), edibles, beverages, tincture or sprays, and topicals (National Academies of Sciences, Engineering, and Medicine (NASEM), 2018). While users typically smoke cannabis by using ‘joints’ (hand-rolled cigarettes), pipes (bowls), water pipes (bongs or hookahs), ‘blunts’ (hollow cigars filled with cannabis) or ‘spliffs’ (tobacco and cannabis mixed in hand-rolled cigarettes), vaping cannabis involves heating dried herb or liquid and inhaling the aerosol through a vaporizer (i.e., volcano) or e-cigarettes. ‘Dabbing’ is another form of vaping cannabis where concentrated cannabis extracts (butane hash oil or honey oil, wax or budder, shatter) are used (NASEM, 2018). Post-legalization statistics from the Canadian Cannabis Survey (CCS) 2019 showed that the majority of the users (84%) used cannabis through smoking, while 27% vaped cannabis using a vape pen or e-cigarette and 15% used a vaporizer (Government of Canada, 2019). Given the recent legalization of cannabis, interest in the health effects of cannabis has increased.

The National Academies of Sciences, Engineering, and Medicine (NASEM) study (2018) concluded that long-term cannabis smoking is substantially associated with increased respiratory symptoms (i.e., cough, phlegm, and wheeze) and more frequent chronic bronchitis episodes than experienced by non-smokers. Many organizations and experts have come forward with recommendations to reduce the health risks associated with cannabis use. For instance, the “Lower-Risk Cannabis Use Guidelines” from the Centre for Addiction and Mental Health (CAMH) have recommended to use alternative methods of cannabis delivery like vaporizers instead of smoking to avoid combustion and reduce respiratory problems (Fischer et al., 2017).

By contrast, recent outbreaks of respiratory illnesses associated with consumption of mostly unregulated Delta-9-tetrahydrocannabinol (THC)-containing vaping products have so far resulted in 2807 hospitalizations and 68 deaths in the United States, with additional cases being investigated in Canada (Centers for Disease Control and Prevention (CDC), 2020, Government of Canada, 2020). This calls into question the relative safety of vaping as a mode of consumption. CDC and the US Food and Drug Administration (FDA) now advise against using THC- or cannabis-containing vaping products (CDC, 2020). This commentary will provide a narrative of available evidence and viewpoints on the relative

harms and harm reduction of vaping cannabis and whether there is sufficient evidence to continue to encourage cannabis vaping over other forms of cannabis ingestion.

## Respiratory effects

Vaporizing cannabis has been found to avoid producing undesired toxic pyrolytic compounds or by-products (e.g., carcinogenic polynuclear aromatic hydrocarbons, benzene, toluene) and reduce exposure to carbon monoxide (CO), thereby lowering risks of respiratory hazards as compared with smoking (Abrams et al., 2007; Gieringer et al., 2004; Spindle et al., 2018). A small non-randomized trial ( $n = 12$ ) reported significantly improved respiratory symptoms and forced vital capacity (FVC) among cannabis smokers who switched to vaping cannabis for 30 days (Van Dam & Earleywine, 2010). Another cross-sectional study found that vaporizer users were 40% less likely to report respiratory effects like cough, phlegm, and chest tightness than users who smoked cannabis, even after controlling for cigarette use and amount of cannabis consumed (Earleywine & Barnwell, 2007). However, there are no published randomized control trials or cohort studies examining respiratory effects of switching to vaporizers.

In contrast, recent investigations by the CDC into the outbreak of e-cigarette or vaping product use-associated lung injury (EVALI) found that 73% of cases reported using THC-containing vaping products at least some of the time, while 33% reported exclusive use of THC-containing vaping products (CDC, 2020). The investigations of the CDC and FDA into the cases of EVALI revealed high concentrations of vitamin E acetate during lung biopsy of EVALI patients. Vitamin E acetate, used as a diluent in most of the unregulated THC-containing vaping products, has the potential to interfere with normal lung functioning (CDC, 2020).

## Cardiovascular effects

The NASEM study (2018) concluded that there is limited evidence of an association between cannabis smoking and acute myocardial infarction, ischaemic stroke, and subarachnoid haemorrhage. While similar heart rate (HR) increases have been found after smoking and vaping cannabis in one study (Newmeyer et al., 2017a, 2017b), another study found that HR increase was significantly greater after vaporizer use (Spindle et al., 2018). However, the long-term impact of using cannabis vaporizers on the cardiovascular system is still unknown. More research is needed to understand the effects on the cardiovascular system of switching to vaping from smoked cannabis.

## Cognitive, psychomotor, and mental health effects

Acute and chronic cannabis use is associated with cognitive impairments of verbal learning, memory, and attention, with more impairment of psychomotor function following acute exposure (Broyd et al., 2016; NASEM, 2018). Randomized controlled trials (RCTs) reported greater cognitive and psychomotor impairment following vaping cannabis than smoking among infrequent users (Spindle et al., 2018), but did not find much difference between smoking and vaping in terms of psychophysical task performance among habitual cannabis users (Newmeyer et al., 2017a, 2017b), which might be due to development of tolerance after chronic exposure.

Changes in cognitive ability may have important implications for real-world safety such as driving. The NASEM study (2018) has concluded that there is substantial evidence of an association between cannabis use and motor vehicle collisions. Driving simulation studies among recreational cannabis users found that vaping cannabis caused acute impairment of complex tasks, lower self-perceived driving ability, and increased lane ‘weaving’ during the car-following task within up to 5 h of cannabis intake (Arnell et al., 2019; Ogourtsova et al., 2018); even using equivalent concentrations of cannabidiol and THC did not reduce the impact of THC or improve driving performance measures (Arnell et al., 2019). These findings suggest that, with respect to driving, vaping any form of cannabis does not provide a safer route of administration than smoking. The Lower-Risk Cannabis Use Guidelines recommend waiting at least 6 h after using cannabis before driving (Fischer et al., 2017).

Cannabis use is associated with the development of psychosis and schizophrenia, anxiety disorder, suicide, depressive disorder, and bipolar disorder (NASEM, 2018). One RCT reported that vaping produced significantly higher rates of acute paranoia among infrequent users compared with smoking (Spindle et al., 2018). However, the acute and chronic mental health impact of switching from cannabis smoking to vaping needs to be explored yet. The Lower-Risk Cannabis Use Guidelines recommend avoiding use of all forms of cannabis by individuals with a family history of psychosis and substance use disorder (Fischer et al., 2017). Moreover, cannabis use at an early age is associated with adolescent brain abnormality and cannabis and other substance use disorder (Jacobus & Tapert, 2014). Hence, actions should be taken to limit access among younger people.

## Subjective and pharmacokinetic effects

One study found that while the subjective peak effects of ‘good drug effect’, ‘high’, ‘stoned’, and ‘stimulated’ on the Visual Analog Scale (VAS) among recreational cannabis users were the same time following *ad lib* smoking and vaping with similar changes in blood THC concentration, the subjective effects of cannabis remained longer after smoking (1.5–3.5 h) than after vaporizer use (0.25–1 h) (Newmeyer et al., 2017a, 2017b). By comparison, another study which used the same doses (10 or 25 mg) of THC among infrequent cannabis users found that subjective ratings were higher following vaped cannabis as compared with smoked cannabis, which was consistent with their findings of higher blood level of THC following vaping (Spindle et al., 2018). It seems that habitual users can titrate doses during vaping while new users cannot. However, as vaping is perceived as safer than smoking, having a better taste, having more intense effects, and allowing greater discretion, young people may try vaping first and develop dependence easily, which should be considered by the policy makers (Budney et al., 2015).

## Therapeutic use

Cannabis has been proven effective and approved for treatment of chronic pain, neuropathic pain, muscle spasticity in multiple sclerosis, and chemotherapy-induced nausea and vomiting (NASEM, 2018). Vaping is proposed to be an effective way of administering therapeutic doses of cannabis due to its better bioavailability compared with oral administration and its avoidance of respiratory hazards in comparison with smoking (Bruni et al., 2018; Gieringer et al., 2004; Varlet et al., 2016). More research should be done with special attention to dosage standardization, association with EVALI, and long-term outcomes of medical cannabis vaping.

## Conclusion

There is a growing concern of increased adverse health outcomes with the availability of different formulations and concentrations of cannabis products on the legal market. Scientists and policy makers are looking for alternatives that can reduce harm and the burden on the health care system caused by cannabis smoking. Available evidence shows that, compared with smoking, vaping cannabis can reduce: exposure to several toxins, CO, and chronic respiratory symptoms while producing similar subjective effects, and hence might

have the potential of harm reduction among habitual cannabis smokers. Moreover, vaping is proposed to be an effective way of delivering therapeutic doses of cannabis as compared with oral route and smoking. Future studies should focus on benefits and harms of switching to vaping dried herbs rather than cannabis smoking among chronic cannabis users, and long-term outcomes of therapeutic cannabis vaping. However, it should be noted that with respect to cognitive, mental health, and driving impairment, as well as the possibility of developing dependence among new users, these benefits are outweighed by harms, and policies should be adopted to limit access among young people. Further, the association of EVALI to THC-containing e-liquids should be investigated thoroughly.

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## Declarations

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