



# Sex, Gender and Cannabis Nicotine Vaping in Youth

## Sex, gender and cannabis and nicotine vaping in youth

In the context of ongoing investigations and debates regarding the benefits and harms of vaping, researchers at the Centre of Excellence for Women's Health have examined the existing sex and gender related factors affecting patterns of use, exposure and health effects of cannabis vaping and electronic nicotine delivery systems (ENDS). However, long term effects of vaping and ENDS are still unknown, and much more research on sex, gender and nicotine and cannabis vaping is necessary to understand and mitigate specific risks for men, women, boys, girls and gender diverse individuals.

## Cannabis vaping and harm reduction

Vaping cannabis has been promoted as a safer alternative to smoking cannabis.

- The Lower Risk Cannabis Use Guidelines for Canada, and Lower Risk Cannabis Use for Youth Guidelines, suggest *avoiding combustible cannabis* and instead, choosing vaping and edibles, based on a 2017 review that identified harmful byproducts in smoked cannabis and adverse respiratory health outcomes associated with smoking [1].
- However, the form of cannabis used, as well as the route of administration (ROA) matters. Vapourizing cannabis flower (dried herb) is recommended, but vapourizing cannabis concentrates has greater harms, including enhanced impairment and potential for injuries [1].

More recently, evidence has emerged of harms associated with vaping cannabis, particularly for youth, such as:

- Contamination of cannabis concentrate vaping products, particularly with vitamin E acetate.
- Reports of e-cigarette or vaping associated lung injury (EVALI). EVALI has primarily affected young males (66%) in the USA [4].
- Case reports described patients presenting with lipid pneumonia, acute respiratory distress syndrome and pulmonary hemorrhage [5].

## The type of vaping device matters

Cannabis vaping devices, their byproducts and health effects may vary depending on the carrier compounds, flavourings, product materials and heating capacity [2, 3].

- Some devices use cartridges that contain cannabinoid extracts combined with propylene glycol, vegetable glycerin and flavours [6].
- There are portable, disposable vape pens as well as rechargeable devices that use dried flower or THC or CBD extracts [6]. Some devices use conduction heat, and others convection heat.
- Stationary vapourizers have tubing or bags/balloons attached to deliver the vapour.
- Dabbing is a method of aerosolizing cannabis concentrates by placing them on a hot surface.

- Vapourizing dried herb is associated with the lowest harm, while vapourizing cannabis concentrates and dabbing increases the risk of negative health effects and injuries [1].
- The long term health effects of cannabis vaping on human health are unknown [1].

### What are electronic nicotine delivery systems (ENDS)?

- ENDS contain nicotine dissolved in a liquid solution, often including vegetable glycerin, propylene glycol and flavourings, that is heated to create an aerosol (vapour) that the user inhales.
- There are disposable and rechargeable devices, some that resemble cigarettes or pens, and larger tank systems or MODS (Mechanical Modified Nicotine Delivery Systems) [6, 7].
- The latest device is the pod mod, such as Juul, that contains nicotine salt e-liquid in disposable pods.
- Other non-combusted tobacco products are available, including heat-not burn products that heat dried tobacco to create an aerosol that is inhaled.

### What is the harm reduction potential of ENDS?

ENDS are being investigated for their harm reduction potential or as tools in tobacco smoking cessation as they produce fewer toxicants and known carcinogens compared to cigarettes [8-10]. But, there is increasing evidence of harms for youth including:

- Frequency and misuse among youth [2, 9]; and dual use of ENDS and cigarette smoking [11-13] leading to a greater risk of misuse and addiction [2].
- Among youth and young adults, the risk of addiction associated with ENDS use is a key public health issue [14]. Among ENDS users, young adults who only use ENDS reported the lowest intention to quit using nicotine products [15].
- The byproducts and health effects of ENDS may vary depending on the carrier compounds, flavourings, product materials and heating capacity [2].
- There is no long term research on nicotine

vaping [16], but emerging evidence suggests vaping related pulmonary illness [14] and adverse effects of ENDS on lung cellular function, organ physiology, cardiovascular and respiratory health and immune function [16-18].

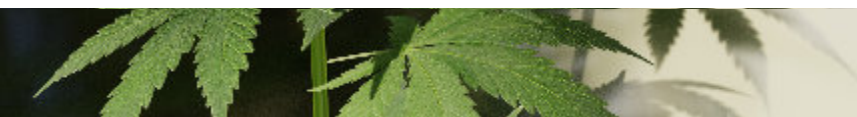
### What do we know about sex, gender and cannabis vaping?

#### Sex related effects of cannabis vaping:

- There is a lack of evidence from human studies on the sex related effects of cannabis vaping.
- Female rats are more sensitive to the hypothermic effects (reduced body temperature) of vaporized THC at lower doses [19] compared to male rats.
- Rats of both sexes become tolerant to the hypothermic and antinociceptive (reduced reaction to potentially painful stimuli) effects after repeated daily THC vapor inhalation [20].
- Plasma THC levels reached after a 30 minute session of vapour inhalation session did not differ between male and female rats [20].

#### Gender, equity and prevalence and patterns of cannabis vaping:

- More boys and young men report vaping cannabis [12, 21] and using cannabis concentrates [22, 23] compared to girls and young women.
- Based on a large US national sample, cannabis vapers were more likely to be: young, male, White and to have initiated cannabis use at an earlier age [12].
- Studies of high school students in the US report greater use of e-cigarette devices to vaporize cannabis among boys [24], or no difference between girls and boys [25].
- In a sample of college students, men and individuals from higher socioeconomic status (SES) families were more likely to report vaping cannabis, while women and individuals from low SES families reported lower rates of vaping [26].
- Vaping devices are designed to target specific user groups, including girls and young women; marketing rebrands cannabis users as “stylish and fashionable” [27].



## What do we know about sex, gender and electronic nicotine delivery systems (ENDS)?

### Sex related effects of ENDS:

- In mice, e-cigarettes promoted mitochondrial depolarization in primary brain vascular endothelial cells (which may affect cerebrovascular tone) but no sex differences were observed [28].
- Following aerosol nicotine exposure there were no sex differences in brain nicotine concentrations in mice [29].
- In a human study, females who were taking oral contraceptives demonstrated more negative changes in vitamin E levels and flow-mediated dilation (widening of artery with increased blood flow in the artery) compared to males after e-cigarette use [30].

### Gender, equity and prevalence and patterns of ENDS:

- Across multiple studies, boys have reported greater prevalence of use of ENDS and poly-tobacco product use [31-43].
- In a Canadian study, past 30 day use of e-cigarettes was associated with initiation of smoking a whole tobacco cigarettes, with slightly higher rates in males (9.5%) than females (7.4%) at follow up [44].
- In a sample of US youth who had tried e-cigarettes, males were more likely to report liking the flavours and taste and perceiving them as less harmful for self and others compared to cigarettes, and liking the ability to use in locations where smoking is prohibited [45].
- Girls who reported cannabis use [3] and perceived stress [46] were more likely to report e-cigarette use.
- A study on the ENDS devices used by high school youth found that those who used vape or hookah pens and multiple devices were more likely to be female [47].
- Among a sample of young adults ages 18–34, females preferred non tobacco and non-menthol flavours of e-cigarettes [48].
- Prevalence of ENDS use is higher for sexual minorities [49-51] and gender minorities [52, 53] compared to non-sexual or gender minorities.

## What next?

More research is urgently needed on the sex-specific health effects of both cannabis and nicotine vaping. Policy and public health approaches to cannabis vaping and ENDS use need to consider how sex-based factors affect health and how decisions, regulations and messaging impact different gender groups.

### References

1. Fischer, B., et al., *Lower-risk cannabis use guidelines: a comprehensive update of evidence and recommendations*. American journal of public health, 2017. **107**(8): p. e1-e12.
2. Budney, A.J., J.D. Sargent, and D.C. Lee, *Vaping cannabis (marijuana): parallel concerns to e-cigs?* Addiction, 2015. **110**(11): p. 1699-1704.
3. Russell, C., et al., *Routes of administration for cannabis use - basic prevalence and related health outcomes: A scoping review and synthesis*. International Journal of Drug Policy, 2018. **52**: p. 87-96.
4. Hammond, D., *Outbreak of pulmonary diseases linked to vaping*. BMJ, 2019. **366**: p. 15445.
5. Xantus, G.Z., *Vaping-associated lung injury—VALI facts, assumptions and opportunities: review of the present situation*. Postgraduate Medical Journal, 2020. **96**(1132): p. 61-63.
6. Centers for Disease Control and Prevention, *E-Cigarette, or Vaping, Products Visual Dictionary* 2019.
7. Truth Initiative, *E-cigarettes: Facts, stats and regulations*. 2019.
8. El Dib, R., et al., *Electronic nicotine delivery systems and/or electronic non-nicotine delivery systems for tobacco smoking cessation or reduction: a systematic review and meta-analysis*. BMJ open, 2017. **7**(2): p. e012680.
9. Kong, G. and S. Krishnan-Sarin, *A call to end the epidemic of adolescent E-cigarette use*. Drug and alcohol dependence, 2017. **174**: p. 215.
10. O'Leary, R., et al., *Claims in vapour device (e-cigarette) regulation: a narrative policy framework analysis*. International Journal of Drug Policy, 2017. **44**: p. 31-40.
11. Chou, S.P., et al., *Prevalence, correlates, comorbidity and treatment of electronic nicotine delivery system use in the United States*. Drug and alcohol dependence, 2017. **178**: p. 296-301.
12. Lee, D.C., et al., *Online survey characterizing vaporizer use among cannabis users*. Drug and alcohol dependence, 2016. **159**: p. 227-233.
13. Cranford, J.A., et al., *Prevalence and correlates of "Vaping" as a route of cannabis administration in medical cannabis patients*. Drug and alcohol dependence, 2016. **169**: p. 41-47.
14. King, B.A., et al., *The EVALI and Youth Vaping Epidemics – Implications for Public Health*. New England Journal of Medicine, 2020.
15. Vu, T.-H.T., et al., *Age differences in electronic nicotine delivery systems (ENDS) usage motivations and behaviors, perceived health benefit, and intention to quit*. Addictive Behaviors, 2019. **98**: p. 106054.
16. Gotts, J.E., et al., *What are the respiratory effects of e-cigarettes?* BMJ, 2019. **366**: p. 15275.
17. Reidel, B., et al., *E-Cigarette Use Causes a Unique Innate Immune Response in the Lung, Involving Increased Neutrophilic Activation and Altered Mucin Secretion*. American Journal of Respiratory and Critical Care Medicine, 2017. **197**(4): p. 492-501.
18. Caporale, A., et al., *Acute Effects of Electronic Cigarette Aerosol Inhalation on Vascular Function Detected at Quantitative MRI*. Radiology, 2019. **293**(1): p. 97-106.

19. Nguyen, J.D., et al., *Inhaled delivery of Delta(9)-tetrahydrocannabinol (THC) to rats by e-cigarette vapor technology*. *Neuropharmacology*, 2016. **109**: p. 112-120.
20. Nguyen, J.D., et al., *Tolerance to hypothermic and antinoceptive effects of 9-tetrahydrocannabinol (THC) vapor inhalation in rats*. *Pharmacology Biochemistry and Behavior*, 2018. **172**: p. 33-38.
21. Johnson, R.M., et al., *Usual Modes of Marijuana Consumption Among High School Students in Colorado*. *Journal of Studies on Alcohol and Drugs*, 2016. **77**(4): p. 580-588.
22. Daniulaityte, R., et al., *A Twitter-based survey on marijuana concentrate use*. *Drug and Alcohol Dependence*, 2018. **187**: p. 155-159.
23. Carrie, C., M.L. K., and S. Michelle, *Sex Differences in Cannabis Use and Effects: A Cross-Sectional Survey of Cannabis Users*. *Cannabis and Cannabinoid Research*, 2016. **1**(1): p. 166-175.
24. Morean, M.E., et al., *High school students' use of electronic cigarettes to vaporize cannabis*. *Pediatrics*, 2015. **136**(4): p. 611.
25. Eggers, M.E., et al., *Youth use of electronic vapor products and blunts for administering cannabis*. *Addictive behaviors*, 2017. **70**: p. 79-82.
26. Jones, C.B., et al., *Prevalence and correlates of vaping cannabis in a sample of young adults*. *Psychology of Addictive Behaviors*, 2016. **30**(8): p. 915.
27. Hakkarainen, P., *Vaporizing the pot world - easy, healthy, and cool*. *Drugs and Alcohol Today*, 2016. **16**(3): p. 185-193.
28. Kaisar, M.A., et al., *Conventional and electronic cigarettes dysregulate the expression of iron transporters and detoxifying enzymes at the brain vascular endothelium: In vivo evidence of a gender-specific cellular response to chronic cigarette smoke exposure*. *Neuroscience Letters*, 2018. **682**: p. 1-9.
29. Lefever, T.W., et al., *Route of administration effects on nicotine discrimination in female and male mice*. *Drug and Alcohol Dependence*, 2019. **204**: p. 107504.
30. Mastrangeli, S., et al., *Predictors of oxidative stress and vascular function in an experimental study of tobacco versus electronic cigarettes: A post hoc analysis of the SUR-VAPE 1 Study*. *Tobacco Induced Diseases*, 2018. **16**.
31. Ali, M., et al., *Risk Profiles of Youth Single, Dual, and Poly Tobacco Users*. *Nicotine & Tobacco Research*, 2016. **18**(7): p. 1614-1621.
32. Barnett, T.E., et al., *Adolescent Electronic Cigarette Use: Associations With Conventional Cigarette and Hookah Smoking*. *American Journal of Preventive Medicine*, 2015. **49**(2): p. 199-206.
33. Geidne, S., et al., *Prevalence and risk factors of electronic cigarette use among adolescents: Data from four Swedish municipalities*. *Nordic Studies on Alcohol and Drugs*, 2016. **33**(3): p. 225-240.
34. Kinnunen, J.M., et al., *A Longitudinal Study of Predictors for Adolescent Electronic Cigarette Experimentation and Comparison with Conventional Smoking*. *International Journal of Environmental Research and Public Health*, 2018. **15**(2).
35. Lindström, M. and M. Rosvall, *Addictive behaviors, social and psychosocial factors, and electronic cigarette use among adolescents: A population-based study*. *Public Health*, 2018. **155**: p. 129-132.
36. Martinasek, M.P., A. Bowersock, and C.W. Wheldon, *Patterns, perception and behavior of electronic nicotine delivery systems use and multiple product use among young adults*. *Respiratory Care*, 2018. **63**(7): p. 913-919.
37. Osibogun, O., et al., *Correlates of poly-tobacco use among youth and young adults: Findings from the Population Assessment of Tobacco and Health study, 2013-2014*. *Drug and Alcohol Dependence*, 2018. **187**: p. 160-164.
38. Perikleous, E.P., et al., *E-Cigarette Use Among Adolescents: An Overview of the Literature and Future Perspectives*. *Frontiers in Public Health*, 2018. **6**.
39. Sampasa-Kanyinga, H. and H.A. Hamilton, *Use of social networking sites, electronic cigarettes, and waterpipes among adolescents*. *Public health*, 2018. **164**: p. 99-106.
40. Kong, G., et al., *Reasons for electronic cigarette experimentation and discontinuation among adolescents and young adults*. *Nicotine & tobacco research*, 2014. **17**(7): p. 847-854.
41. Montreuil, A., et al., *Prevalence and correlates of electronic cigarette use among Canadian students: cross-sectional findings from the 2014/15 Canadian Student Tobacco, Alcohol and Drugs Survey*. *CMAJ open*, 2017. **5**(2): p. E460.
42. Suris, J.-C., A. Berchtold, and C. Akre, *Reasons to use e-cigarettes and associations with other substances among adolescents in Switzerland*. *Drug and alcohol dependence*, 2015. **153**: p. 140-144.
43. Simon, P., et al., *Socioeconomic status and adolescent e-cigarette use: The mediating role of e-cigarette advertisement exposure*. *Preventive Medicine*, 2018. **112**: p. 193-198.
44. Hammond, D., et al., *Electronic cigarette use and smoking initiation among youth: a longitudinal cohort study*. *Cmaj*, 2017. **189**(43): p. E1328-E1336.
45. Hong, H., et al., *The impact of local regulation on reasons for electronic cigarette use among Southern California young adults*. *Addictive Behaviors*, 2019. **91**: p. 253-258.
46. Leventhal, A.M., et al., *Perceived stress and poly-tobacco product use across adolescence: Patterns of association and gender differences*. *Journal of Psychiatric Research*, 2017. **94**: p. 172-179.
47. Krishnan-Sarin, S., et al., *E-cigarette devices used by high-school youth*. *Drug and Alcohol Dependence*, 2019. **194**: p. 395-400.
48. Chen, J.C., et al., *Prospective predictors of flavored e-cigarette use: A one-year longitudinal study of young adults in the U.S*. *Drug and Alcohol Dependence*, 2018. **191**: p. 279-285.
49. Ganz, O., et al., *Tobacco harm perceptions and use among sexual and gender minorities: Findings from a national sample of young adults in the United States*. *Addictive Behaviors*, 2018. **81**: p. 104-108.
50. Dai, H.Y., *Tobacco Product Use Among Lesbian, Gay, and Bisexual Adolescents*. *Pediatrics*, 2017. **139**(4).
51. Li, J.J., et al., *Sex and sexual orientation in relation to tobacco use among young adult college students in the US: a cross-sectional study*. *Bmc Public Health*, 2018. **18**.
52. Buchting, F.O., et al., *Transgender use of cigarettes, cigars, and e-cigarettes in a national study*. *American journal of preventive medicine*, 2017. **53**(1): p. e1-e7.
53. Hinds, J.T., A. Loukas, and C.L. Perry, *Sexual and gender minority college students and tobacco use in Texas*. *Nicotine & Tobacco Research*, 2018. **20**(3): p. 383-387.