



ELSEVIER

Contents lists available at ScienceDirect

## Preventive Medicine

journal homepage: [www.elsevier.com/locate/ypmed](http://www.elsevier.com/locate/ypmed)

## Correspondence

## Disregarding the impact of nicotine on the developing brain when evaluating costs and benefits of noncombustible nicotine products



Dear Editor,

I read with interest the review article by Abrams et al. (Abrams et al., 2018) *Managing nicotine without smoke to save lives now: Evidence for harm minimization*. I found that the authors' argument for their noncombustible nicotine product (NNP) harm minimization framework repeatedly justified the rampant spread of NNP use among youth (USDHHS, 2016), with the effectiveness of NNPs as a cessation aid for adult cigarette smokers. Their argument ignores a robust body of evidence demonstrating the impact of chronic nicotine exposure on the developing brain.

Through NNPs, youth are being repeatedly administered doses of nicotine, the highly addictive substance in combustible cigarettes. Repeated exposure to nicotine, even via non-carcinogenic administration routes, leads to neuroplastic changes in neurocircuitry vital for reward processing mechanisms and, in turn, learning and decision making (Dani & De Biasi, 2001; Montague et al., 1996; Kandel & Kandel, 2014; Dowd & Tiffany, 2018). Adolescents are especially vulnerable to these neuro-cognitive effects as their brain is still rapidly developing (Chambers et al., 2003). Dysregulating fundamental neurocognitive processes will likely have substantial downstream consequences on psychical and mental health trajectories (Boden et al., 2010; Buhler et al., 2010) that cannot be ignored when weighing the harms of NNP use among youth.

Additionally, youth that regularly use e-cigarettes will very likely develop a nicotine addiction which has serious neurocognitive consequences beyond just an increased risk to start smoking combustible cigarettes. Once nicotine dependence is established, regular administration is needed to avoid aversive somatic and affective nicotine withdrawal symptoms which include irritability, anhedonia, craving, anxiety, loss of concentration, restlessness, decreased heart rate, depressed mood, impatience, insomnia, increased appetite, weight gain and negative affect (Hughes et al., 1991). However, the ability to regularly self-administer nicotine, even via e-cigarettes, may be limited by public smoking regulations or monetary restraints. Consequently, youth using NNPs could very likely be plagued with the life-long burden of evading significantly disruptive nicotine withdrawal symptoms.

Until more evidence is accumulated, the net costs and benefits of NNPs on the tobacco epidemic will remain under debate. In the meantime, potentially long-term consequences on youth, a vulnerable population with no legal voice, cannot be marginalized or rationalized.

Empirical evidence accumulated from medical, psychological and neuroscience fields must be considered thoughtfully and objectively when forming regulation policy with significant implications for public health.

### Conflicts of interest

None.

### References

- Abrams, D.B., Glasser, A.M., Villanti, A.C., Pearson, J.L., Rose, S., Niaura, R.S., 2018. Managing nicotine without smoke to save lives now: evidence for harm minimization. *Prev. Med.* 117, 88–97.
- Boden, J.M., Fergusson, D.M., Horwood, L.J., 2010. Cigarette smoking and depression: tests of causal linkages using a longitudinal birth cohort. *Br. J. Psychiatry* 196 (6), 440–446.
- Buhler, M., Vollstadt-Klein, S., Kobiella, A., Budde, H., Reed, L.J., Braus, D.F., et al., 2010. Nicotine dependence is characterized by disordered reward processing in a network driving motivation. *Biol. Psychiatry* 67 (8), 745–752.
- Chambers, R.A., Taylor, J.R., Potenza, M.N., 2003 Jun 1. Developmental neurocircuitry of motivation in adolescence: a critical period of addiction vulnerability. *Am. J. Psychiatr.* 160 (6), 1041–1052.
- Dani, J.A., De Biasi, M., 2001. Cellular mechanisms of nicotine addiction. *Pharmacol. Biochem. Behav.* 70 (4), 439–446.
- Dowd, A.N., Tiffany, S.T., 2018 Jul. Comparison of tobacco and electronic cigarette reward value measured during a Cue-reactivity task: an extension of the choice-behavior-under-cued-conditions (CBUCC) procedure. *Nicotine Tob. Res.* 1, 7.
- Hughes, J.R., Gust, S.W., Skoog, K., Keenan, R.M., Fenwick, J.W., 1991 Jan 1. Symptoms of tobacco withdrawal: a replication and extension. *Arch. Gen. Psychiatry* 48 (1), 52–59.
- Kandel, E.R., Kandel, D.B., 2014 Sep 4. A molecular basis for nicotine as a gateway drug. *N. Engl. J. Med.* 371 (10), 932–943.
- Montague, P.R., Dayan, P., Sejnowski, T.J., 1996. A framework for mesencephalic dopamine systems based on predictive Hebbian learning. *J. Neurosci.* 76 (5), 1936–1947.
- U.S. Department of Health, Services, Human, 2016. E-Cigarette Use Among Youth and Young Adults. In: A Report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, Retrieved from. [http://ecigarettes.surgeongeneral.gov/documents/2016\\_sgr\\_full\\_report\\_non-508.pdf](http://ecigarettes.surgeongeneral.gov/documents/2016_sgr_full_report_non-508.pdf).

Jessica S. Flannery

Department of Psychology, Florida International University, 11200 S.W. 8th Street, Miami, FL 33199, USA

E-mail address: [jflanner@fiu.edu](mailto:jflanner@fiu.edu).

<https://doi.org/10.1016/j.ypmed.2018.11.023>

Received 21 November 2018; Accepted 30 November 2018

0091-7435/© 2018 Elsevier Inc. All rights reserved.