Nicotine exposure from smoking tobacco and vaping among adolescents

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Abstract

Importance It remains unknown whether nicotine intake among youths who vape is lower, comparable, or higher than among youths who smoke.

Objective To examine potential differences in biomarkers of exposure to nicotine (1) between adolescents who smoke tobacco, vape, both vape and smoke (dual use), or do not use; (2) between adolescents in 3 countries; and (3) by nicotine content and form in the vaping product last used among adolescents who exclusively vaped.

Design, Setting, and Participants This population-based, observational cross-sectional study invited adolescents aged 16 to 19 years in Canada, England, and the US who had previously completed national surveys to participate in a biomarker study based on their vaping and smoking status. Participants completed questionnaires and self-collected urine samples between September 2019 and January 2022. Analyses were conducted in February 2023 and between January and June 2024.

Exposures Vaping, tobacco smoking, dual use, or no use in the past 7 days.

Main Outcomes and Measures Urine concentration of cotinine, trans-3'-hydroxycotinine (3OH-cotinine), and total nicotine equivalents (TNE-2; molar sum of cotinine and 3OH-cotinine), normalized for creatinine concentration.

Results Among the 364 participants (mean [SD] age, 17.6 [1.1] years; 203 females [55.8%]) who provided usable urine samples and completed questionnaires, no differences in TNE-2 concentration were observed between adolescents who exclusively vaped (n = 73; geometric mean [SD], 3.10 [16.69] nmol/mg creatinine), exclusively smoked (n = 68; geometric mean [SD], 3.78 [18.00] nmol/mg creatinine), or both vaped and smoked (n = 77; geometric mean [SD], 6.07 [19.08] nmol/mg creatinine) in the past week, adjusting for creatinine concentration, age, sex, country, and cannabis use. All vaping and/or smoking groups had higher concentrations of TNE-2 than no use (n = 146; geometric mean [SD], 0.19 [1.14] nmol/mg creatinine; P < .001 for all contrasts). Among adolescents who exclusively vaped (n = 73), TNE-2 concentrations were not significantly different between those who reported using products containing more than 20 mg/mL nicotine (n = 33; geometric mean [SD], 4.35 [18.25] nmol/mg creatinine) and containing 20 mg/mL nicotine or less (n = 28; geometric mean [SD], 5.13 [15.64] nmol/mg creatinine). Reported use of vaping products containing nicotine salts (n = 23) was associated with higher concentration of TNE-2 (geometric mean [SD], 10.78 [18.03] nmol/mg creatinine) than reported use of products without nicotine salts (n = 29; geometric mean [SD], 2.72 [15.42] nmol/ng creatinine; P = .03) or reporting "don't know" (n = 14; geometric mean [SD], 1.55 [15.01] nmol/ng creatinine; P = .009). Similar patterns of exposure were observed for cotinine and 3OH-cotinine.

Conclusions and Relevance This cross-sectional study found that vaping was associated with similar nicotine exposure as smoking among adolescents. Reported use of a nicotine salt product was associated with higher nicotine exposure among those who exclusively vaped, consistent with findings from laboratory and population studies indicating greater dependence for nicotine salt e-cigarettes.