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E-cigarette and tobacco product use among NYS youth before and after a state-wide vaping flavour restriction policy, 2020–2021

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ABSTRACT

Significance Reducing youth e-cigarette use is a New York State (NYS) public health priority. In May 2020, a state-wide restriction on flavoured e-cigarettes, except tobacco flavour, was passed. This study examines changes in nicotine product use behaviour among youth around the time of the state-wide vaping flavour restriction.

Methods NYS data from the US International Tobacco Control Policy Evaluation Project Youth Tobacco and E-cigarette Tobacco and Vaping Survey were analysed cross-sectionally from February 2020 (n=955), August 2020 (n=946), February 2021 (n=1030) and August 2021 (n=753). Online surveys were conducted among youth 16–19 years. Weighted descriptive statistics and regression models were used to describe changes in nicotine product use behaviour. Models were adjusted for age, sex, race/ethnicity and perceived family socioeconomic status.

Results Significant decreases in past 30-day e-cigarette use (20%–11%), cigarette (7%–4%), and dual use of e-cigarettes and cigarettes (5%–2%) were observed over the 2-year period in NYS. Over 95% of vapers still reported using a non-tobacco-flavoured e-cigarette following the restriction, with fruit-flavoured being the most popular at each time point.

Conclusions Nearly all NYS youth continued to vape flavours that were restricted in NYS. While youth past 30-day vaping prevalence decreased significantly from 2020 to 2021, increased flavour restriction compliance could result in an even greater decrease. Continuous monitoring is important to better understand perceptions, use patterns and access at the individual level, retail level and population level to inform future enforcement and restrictions.

INTRODUCTION

The availability of various flavoured electronic cigarettes is enticing to both new consumers and established users.^{1–5} Flavour additives in e-cigarettes have been shown to reduce the perceived harshness of nicotine, which may facilitate increased inhalation, increased nicotine delivery and increased appeal, and ultimately promote experimentation among youth.^{6–13} The US Food and Drug Administration (FDA) has expressed concern that certain flavoured e-cigarettes (eg, JUUL) are appealing to youth who may be unaware of the products' addictiveness and otherwise may have never tried a nicotine product.^{14 15} Former FDA Commissioner Gottlieb characterised e-cigarette use among youth as an

WHAT WE ALREADY KNOW ON THIS TOPIC

⇒ The availability of flavours in e-cigarettes reduces the perceived harshness of nicotine, increases appeal and may promote experimentation among youth. Therefore, restrictions on flavours in e-cigarettes have the potential to reduce the appeal and prevalence of e-cigarette use.

WHAT THIS STUDY ADDS

⇒ Despite a state-wide restriction of flavoured e-cigarettes in New York State (NYS), nearly all youth were vaping restricted flavours more than a year following its implementation.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE, OR POLICY

⇒ Continued monitoring of user behaviours and perceptions, as well as retailer compliance, following the state-wide restriction of flavoured e-cigarettes in NYS is needed to identify areas for improvement, as well as to understand the effects of changes and other policies that may be implemented. Further, a more comprehensive policy (eg, including other flavoured nicotine products; implementation of a nationwide restriction) would lead to a greater reduction in access to appealing nicotine products, such as e-cigarettes.

'epidemic',¹⁶ and reducing youth e-cigarette initiation is a stated New York State Tobacco Control Program (NYS TCP) priority.¹⁷

After initial attempts at flavour restrictions in 2019 (in response to growing youth e-cigarette use and incidence of E-cigarette or Vaping Use-Associated Lung Injury (EVALI)) were reversed,^{18 19} NYS took action and passed a state-wide restriction on all flavoured e-cigarettes, except 'tobacco' flavour and 'unflavored', for both retail (May 2020) and online sales (July 2020), during the COVID-19 pandemic.²⁰ In addition to restricting flavoured e-cigarettes, the policy prohibits the sale of nicotine products in pharmacies and the delivery of e-cigarettes to residential addresses in NYS.²¹ These restrictions were added to the FDA's enforcement of the deeming rule on the manufacturing, distribution and sale of flavoured (other than tobacco or menthol) cartridge-based e-cigarettes for which a premarket tobacco product application had not been authorised, implemented in February 2020.¹⁵



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Following the regulation of flavoured e-cigarettes in NYS, a fuller assessment of its impact on tobacco product use, availability of e-cigarette products and consumer perceptions is needed to ensure that flavoured e-cigarette use decreased without unintended consequences. For example, vaping prevalence could be unchanged if flavoured vapers find ways to circumvent the restriction and purchase products from illicit sources, or switch to another flavoured tobacco product (eg, smokeless tobacco). In addition, if youth are vaping for the flavour, it may be expected that prevalence of vaping would decrease by removing this appealing characteristic of the product. Finally, it may be expected that frequency of vaping might be impacted, with daily users potentially decreasing use of e-cigarettes, switching to a different flavour (eg, tobacco flavour, other flavoured product) or supplementing with another tobacco product (eg, cigarettes, smokeless tobacco) to maintain their nicotine use. The purpose of this study is to examine changes in use of e-cigarettes, as well as other nicotine products, and vaping behaviour among youth before and after the state-wide vaping flavour restriction policy.

METHODS

Study design and participants

The International Tobacco Control Policy Evaluation Project Youth Tobacco and E-cigarette (ITC Youth) Survey assesses youth (16–19 years) e-cigarette use in the USA, Canada and England to better understand predictors of uptake and the impact of policies on use behaviours.²² Surveys across countries were similar, with questions based on the census, including race/ethnicity, region and education, tailored for each country. This analysis uses cross-sectional NYS data from Waves 3.5 (February 2020; n=955), 4 (August 2020; n=946), 4.5 (February 2021; n=1030) and 5 (August 2021; n=753) of the US ITC Youth Survey to examine nicotine product use behaviour and perceptions before and after the NYS vaping flavour restriction policy. Data were collected via online surveys among a random sample of youth recruited from US Nielsen consumer panels, either directly or through their parents. Respondents from previous waves who were still panel members were recruited again, with additional members recruited to reach the target of 4500. Respondents in NYS were oversampled to ensure sufficient numbers for state-specific analysis. Surveys were conducted in English in the USA and took approximately 15 minutes to complete; participants who completed the survey received remuneration per the Nielsen panel's usual incentive structure. Prior to completion of the survey, participant assent with parental consent was obtained for respondents under age 18 years; consent was obtained for respondents 18 years and older. Additional information on the study methods can be found in the Technical Report (<http://davidhammond.ca/projects/e-cigarettes/itc-youth-tobacco-ecig/>).

Measures

Nicotine product use

Past 30-day use of cigarettes, e-cigarettes, little cigars/cigarillos, cigars, bidis, smokeless, nicotine replacement therapy, oral nicotine products and waterpipe was assessed at each time point. Descriptive text and images were used for e-cigarettes to help respondents with identification, while descriptive text alone was used for other products.

E-cigarette flavours

E-cigarette flavour(s) used most often in the past 30 days was assessed at each time point with a 'check all that apply' option. Options for flavour used included (1) Tobacco, (2) Tobacco and menthol, (3)

Menthol or mint, (4) Fruit, (5) Candy, chocolate, dessert or sweets, (6) Clove or other spice, (7) Coffee, (8) Non-alcoholic drink, (9) Alcoholic drink, (10) Another flavour, (11) Unflavoured, (12) Don't know or (13) Refused. All potential flavour combinations were first assessed, then flavour use was dichotomised to exclusive 'tobacco' flavour use (response 1, only) versus everyone else who used at least one non-tobacco flavour. No respondents reported using unflavoured e-cigarettes exclusively in the past 30 days. There were 14 past 30-day vapers (February 2020: n=5; August 2020: n=3; February 2021: n=3; August 2021: n=3) who reported a 'Don't know' or had missing data for past 30-day flavour use but were included in the flavour use assessment.

E-cigarette vaping frequency

Frequency of past 30-day vaping was derived. Daily vapers were those who vaped in 30 days of the past 30 days. Frequent vapers were those who vaped 20+ days in the past 30 days and were not daily vapers. Finally, infrequent users were those who vaped fewer than 20 days in the past 30 days.

Reasons for vaping

Reasons for vaping were assessed at all time points in a 'check all that apply' format. Response options included (1) Curiosity/to try something new, (2) For fun/I like it, (3) For the flavour, (4) For the nicotine, (5) To deal with stress or anxiety, (6) I can vape in places where I can't smoke, (7) To cut down the number of cigarettes I smoke, (8) To help me quit smoking cigarettes, (9) To help me stay quit, (10) To vape cannabis/marijuana or other drugs, (11) Vaping is less expensive than smoking, (12) Vaping may be less harmful to me than smoking, (13) Vaping may be less harmful to people around me than smoking, (14) Vaping is more acceptable to people around me than smoking or (15) Some other reason.

E-cigarette purchasing behaviours

Respondents were asked how they got their e-cigarette in the past 30 days and to select all that applied to them. Options included: (1) Someone offered/gave them to me, (2) I bought them myself from a store, (3) I bought them over the internet/online, (4) I gave someone else money to buy them for me, (5) I bought them from another person, (6) I took them from a store or another person, (7) I got a free sample, (8) I got them some other way (please specify), (9) Don't know and (10) Refused. Responses were collapsed into three groups: (1) Obtained products myself in the past 30 days (from above: 2 and 3), (2) Someone else obtained the products for me (from above: 1, 4 and 5), and (3) Other (from above: 6, 7 and 8). Respondents who reported a response that fit in two or more of the collapsed groups were categorised as obtaining the products themselves. Retailers should not be selling tobacco products to youth under 21 years following the 2019 Tobacco 21 (T21) amendment of the Federal Food, Drug, and Cosmetic Act,²³ which will help to understand the association of contemporaneous events and vaping behaviour. Among respondents who reported obtaining products for themselves from a store in the past 30 days, they received a follow-up question that asked what kind of stores they bought it from. Options included: (1) From a vape shop, (2) From a regular store (convenience/gas station, supermarket, etc), (3) From a pharmacy, (4) From some other kind of store (please specify), (5) Don't know and (6) Refused. These store options were collapsed into two categories: (1) Vape shop and (2) Retail store/other.

Covariates

Demographic characteristics were assessed at each time point. Variables included age (continuous), sex (male/female), race/ethnicity (non-Hispanic white/other/don't know or refused), and perceived family socioeconomic status (SES; not meeting basic expenses/just meeting basic expenses/meeting needs with a little left over/living comfortably/don't know or refused).

Statistical analysis

Analyses were limited to respondents living in NYS. Descriptive statistics were used to describe cross-sectional changes in sample demographics, nicotine product use behaviour, e-cigarette flavour use, reason for e-cigarette use and e-cigarette purchasing behaviour over time. Regression models allowed for the assessment of changes in the likelihood of product use and flavour use. Regression models included survey wave, age, sex, race/ethnicity and perceived SES. Contrast statements were used to test trends over time. Finally, to determine if NYS past 30-day e-cigarette and flavour use was differentially affected by the flavour restriction, a factorial interaction term was included in the logistic regression models. Respondents from states with an e-cigarette flavour restriction were excluded, including California, Massachusetts, New Jersey and Rhode Island. All analyses were weighted using the cross-sectional sample weights. The weights were determined based on sex, age, NYS region, race/ethnicity, student status, school grades and nationally representative estimates of past 30-day smoking status. Therefore, our sample is statistically generalisable to the NYS population. A value of $p \leq 0.05$ was considered statistically significant. Analyses were conducted using Stata V.15 software (StataCorp, College Station, Texas).

RESULTS

Sample characteristics

NYS youth respondents from February 2020, August 2020, February 2021 and August 2021 did not differ significantly on age, sex or race/ethnicity, but did on perceived family SES ($p=0.0460$); see online supplemental table 1. Past 30-day e-cigarette use ($p<0.0001$), cigarette use ($p<0.0001$) and dual use of e-cigarette and cigarettes ($p=0.0002$) significantly changed over the 2-year period (see figure 1). The past 30-day use of little cigars/cigarillos, cigars, bidis, smokeless, nicotine replacement

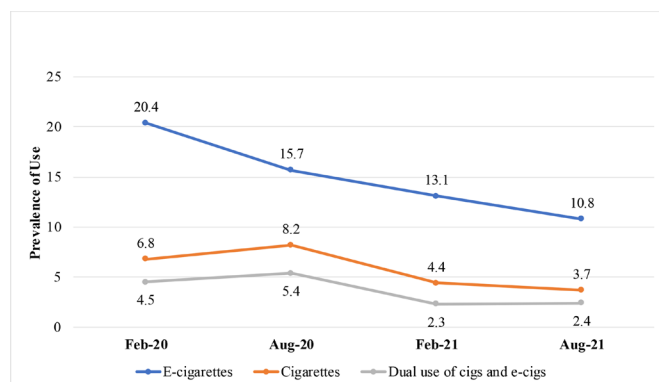


Figure 1 Use of cigarettes and e-cigarettes in the past 30 days among New York State youth—findings from the International Tobacco Control Policy Evaluation Project Youth Tobacco and E-cigarette (ITC Youth) Survey 2020–2021. Note: Past 30-day use of little cigars/cigarillos, cigars, bidis, smokeless, nicotine replacement therapy, oral nicotine products and waterpipe tobacco did not significantly change and is therefore not shown.

therapy, oral nicotine products and waterpipe tobacco did not significantly change over the 2-year period (all $p>0.06$).

Past 30-day vaper characteristics

Similar to the entire NYS respondent population, the NYS past 30-day e-cigarette users did not differ among February 2020, August 2020, February 2021 and August 2021 on age, sex, or race/ethnicity or vaping frequency, but did on perceived SES ($p=0.0102$) and past 30-day cigarette use ($p=0.0120$). Vapers were primarily 17 years or 18 years of age, non-Hispanic white, perceived their SES to be meeting needs with a little leftover or living comfortably, vaped infrequently and did not use any other nicotine product in the past 30 days (see table 1). Compared with February 2020 (22.2%), significantly more past 30-day e-cigarette users smoked cigarettes in August 2020 (34.1%), but then decreased in February 2021 to 17.9% and increased again to 22.0% ($p=0.0120$; see table 1). Further, past 30-day vapers were more likely to report past 30-day cigarette use in August 2020 (adjusted OR (aOR): 2.30; 95% CI 1.29 to 4.10), but were not significantly different from February 2020 in February 2021 and August 2021.

Past 30-day use of flavoured e-cigarettes

Prior to the implementation of the e-cigarette flavour restriction in NYS, 96.1% of past 30-day vapers used a non-tobacco-flavoured product, and 1.4% reported exclusive use of tobacco-flavoured products. Use of any non-tobacco flavour did not change significantly at the following time points postrestriction ($p=0.9548$) with more than 95% of vapers still reporting using a non-tobacco-flavoured e-cigarette following the restriction. Exclusive use of tobacco flavour in the past 30 days did not change significantly either ($p=0.4000$). Further, changes over the 2-year period in exclusive use of tobacco-flavoured e-cigarettes or any non-tobacco-flavoured product did not differ based on frequency of vaping in the past 30 days (all $p>0.1$; see figure 2). Fruit flavour use in the past 30 days was the most popular flavour reported at all time points (59.8%, 71.7%, 70.7% and 73.2%, respectively), followed by menthol or mint (39.8%, 33.4%, 31.0% and 29.7%, respectively; see figure 3). Despite prohibiting the sale of flavoured e-cigarettes in NYS, there was no significant decreased likelihood of using a flavoured product in August 2020 (aOR: 0.74, 95% CI 0.19 to 2.82), February 2021 (aOR: 0.57, 95% CI 0.15 to 2.08) and August 2021 (aOR: 2.06, 95% CI 0.35 to 11.97) when compared with February 2020 after adjustment for age, sex, race/ethnicity and perceived SES. Further, at each time point, a third or more of past 30-day youth vapers reported using their e-cigarette in the past 30 days for the flavour (38.2%, 32.9%, 37.1 and 34.7%, respectively), which did not change significantly even after implementing the flavour restriction. Finally, the rate of change of past 30-day e-cigarette use and past 30-day flavour use among past 30-day vapers did not significantly differ between the NYS and all states without a flavour restriction.

E-Cigarette purchase location

Most respondents reported obtaining their e-cigarette products in the past 30-days from someone else in February 2020 and August 2020 (47.9% and 46.6%, respectively). In February 2021 and August 2021, most reported obtaining their products themselves (49.8% and 49.2%, respectively). There was no significant change in the prevalence of past 30-day youth vapers who bought their e-cigarette products themselves from a store versus those who bought their products themselves over the internet/

Table 1 Demographic characteristics of past 30-day youth vapers by wave of response in New York State—findings from the International Tobacco Control Policy Evaluation Project Youth Tobacco and E-cigarette (ITC Youth) Survey 2020–2021

| | Current vaper | | | | p value |
|--|---------------|-------------|---------------|-------------|---------|
| | February 2020 | August 2020 | February 2021 | August 2021 | |
| | n=211 | n=141 | n=143 | n=106 | |
| Age, N (%) | | | | | 0.4648 |
| 16 years | 33 (16.5) | 26 (17.9) | 22 (13.1) | 15 (11.3) | |
| 17 years | 35 (17.4) | 43 (29.1) | 44 (28.3) | 29 (27.7) | |
| 18 years | 80 (38.3) | 36 (26.8) | 47 (33.5) | 31 (35.7) | |
| 19 years | 63 (27.9) | 36 (26.3) | 30 (25.2) | 31 (25.3) | |
| Sex, N (%) | | | | | 0.1718 |
| Male | 73 (53.4) | 52 (48.4) | 37 (38.1) | 37 (52.4) | |
| Female | 138 (46.6) | 89 (51.6) | 106 (61.9) | 69 (47.6) | |
| Race/ethnicity, N (%) | | | | | 0.8521 |
| Non-Hispanic white | 141 (82.1) | 88 (84.0) | 92 (82.4) | 57 (77.7) | |
| Other | 69 (17.5) | 52 (15.5) | 49 (16.9) | 48 (21.4) | |
| Don't know/refused | 1 (0.39) | 1 (0.41) | 2 (0.75) | 1 (0.98) | |
| Perceived family SES, N (%) | | | | | 0.0102 |
| Not meeting basic expenses | 15 (5.0) | 5 (2.0) | 9 (4.3) | 4 (1.4) | |
| Just meeting basic expenses | 41 (18.1) | 42 (25.8) | 43 (27.3) | 32 (30.5) | |
| Meeting needs with a little left over | 72 (34.5) | 58 (47.6) | 40 (26.5) | 30 (27.7) | |
| Living comfortably | 75 (39.5) | 33 (22.4) | 46 (38.7) | 40 (40.4) | |
| Don't know/refused | 8 (3.0) | 3 (2.3) | 5 (3.3) | 0 | |
| Vaping frequency, N (%) | | | | | 0.3207 |
| Infrequent (<20 days) | 133 (64.3) | 96 (61.1) | 93 (61.3) | 71 (64.0) | |
| Frequent (20–29 days) | 28 (13.8) | 14 (15.1) | 13 (7.7) | 19 (19.3) | |
| Daily | 50 (21.9) | 31 (23.8) | 37 (31.0) | 16 (16.7) | |
| Past 30-day use of cigarettes, N (%) | | | | | 0.012 |
| No | 143 (77.8) | 83 (65.9) | 101 (82.1) | 58 (78.0) | |
| Yes | 68 (22.2) | 58 (34.1) | 42 (17.9) | 48 (22.0) | |
| How past 30-day vapers got their products in the past 30 days, N (%) | | | | | 0.9738 |
| Myself | 97 (47.2) | 68 (46.5) | 72 (49.9) | 50 (49.2) | |
| Someone else | 103 (47.9) | 67 (46.6) | 62 (42.5) | 49 (45.2) | |
| Other | 11 (4.9) | 6 (7.0) | 9 (7.7) | 7 (5.6) | |
| Where past 30-day vapers purchased their products themselves, N (%)* | | | | | 0.6105 |
| Vape shops | 62 (74.6) | 39 (80.1) | 39 (69.0) | 29 (80.9) | |
| Retail store | 23 (25.4) | 9 (20.0) | 22 (31.0) | 13 (19.2) | |

χ^2 analyses were used to determine p values. Values of $p < 0.05$ were considered significantly different.

*Where past 30-day vapers purchased their products themselves was only assessed among those who got their products themselves. SES, socioeconomic status.

online. Among those who purchased their product themselves, most reported purchasing them at a vape shop at each time point (74.6%, 80.1%, 69.0% and 80.9%, respectively). Purchasing behaviour did not significantly change over time; in particular, the purchasing source (obtained them myself vs from someone else) and location (vape shop vs retail stores) of flavoured e-cigarettes did not change pre-NYS e-cigarette flavour restriction to post-NYS e-cigarette flavour restriction.

DISCUSSION

The use of non-tobacco flavours did not change from February 2020 to August 2021, with the vast majority of youth continuing to report vaping non-tobacco flavours in the past 30 days, which were restricted in NYS (May 2020).²¹ Fruit flavour was most often used in the past 30 days at each time point, followed by mint or menthol. Many youth in NYS reported vaping for the flavour in the past 30 days. While flavour could be interpreted by the respondent as referring to the characterising flavour of the product or the overall taste of the product, the continued access to restricted flavours could be maintaining appeal and use among

youth.^{6–13} Further, these analyses found that past 30-day e-cigarette use decreased significantly postrestriction with each subsequent survey. The NYS restriction may be associated with the quitting or switching from e-cigarettes among the more dependent or more wedded-to flavours than e-cigarettes. However, this observation is likely due to the decreasing national trend in e-cigarette use, as we did not see any significant difference in the rate of change between NYS and states without an e-cigarette flavour restriction. In addition to the various e-cigarette-related policies, the USA was also facing the COVID-19 pandemic, with the first case in NYS identified in March 2020.²⁴

Although unlikely among youth, stockpiling in anticipation of the flavour restriction is one explanation for these findings. However, it could also be due to manufacturer and/or retailer non-compliance with the restriction. While Information Resources, Multi-Outlet +Convenience data and Nielsen data show a decrease in non-tobacco-flavoured e-cigarette products on the NYS retail market,^{25 26} they do not capture all means of sales (eg, vape shops, online sales). Major retailers, such as 7-Eleven, Circle K, Speedway, may no longer carry

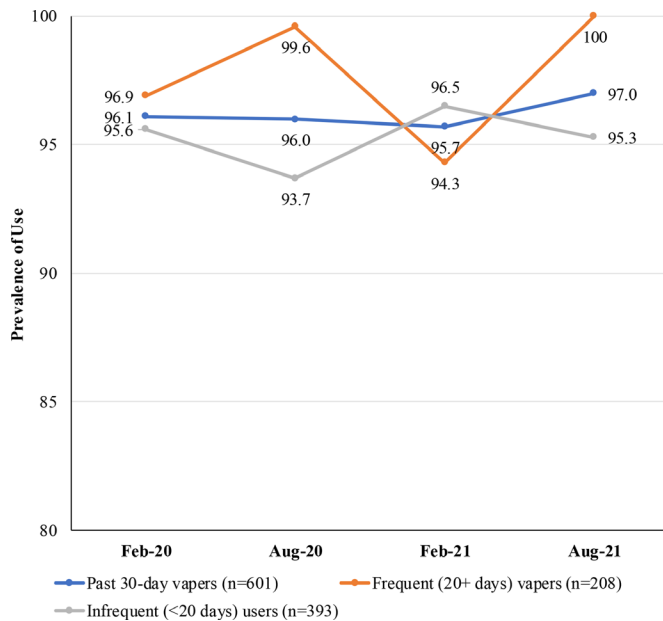


Figure 2 Past 30-day use of any non-tobacco flavour use in among past 30-day vapers in New York State—findings from the International Tobacco Control Policy Evaluation Project Youth Tobacco and E-cigarette (ITC Youth) Survey 2020–2021. Note: There were 14 past 30-day vapers (February 2020: n=5; August 2020: n=3; February 2021: n=3; August 2021: n=3) who reported 'Don't know' or had missing data for past 30-day flavour use but were included in the flavour use assessment.

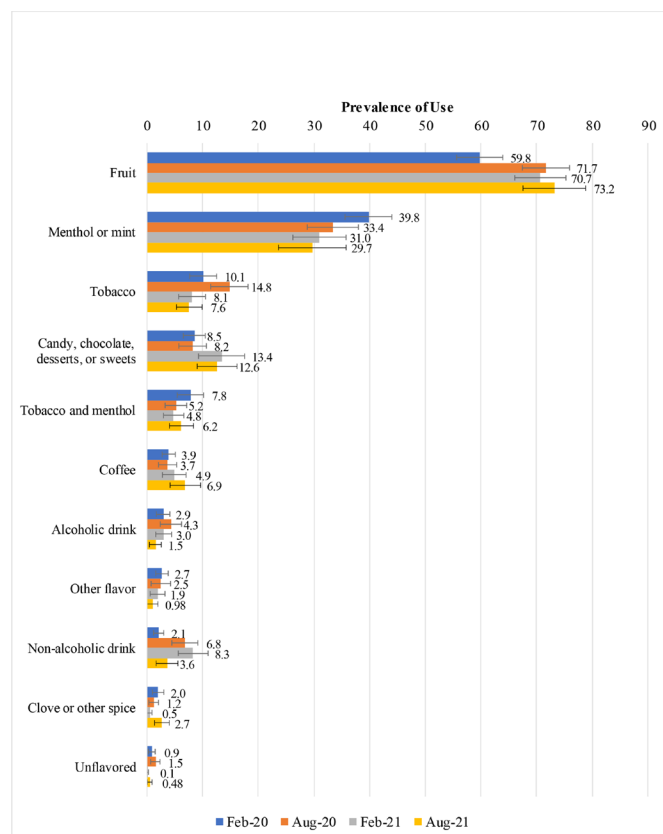


Figure 3 Use of e-cigarette flavours, alone or in combination, among past 30-day youth vapers in New York State—findings from the International Tobacco Control Policy Evaluation Project Youth Tobacco and E-cigarette (ITC Youth) Survey 2020–2021.

non-tobacco-flavoured e-cigarettes, but smaller, family or locally owned, or other retailers may not be captured in these data. In addition, some bordering states do not have a flavour restriction, so products could be brought in from other states by consumers and retailers. Other recent studies assessing the e-cigarette retail environment observed compensation by both consumers and retailers when regulations were implemented.^{27 28} In the absence of flavoured cartridge-based e-cigarettes, flavoured disposable products sales rose.²⁷ Further, retailers began to expand their online marketing and sales.²⁸ These both indicate that partial regulation and state-level regulation do not appear to be sufficient to reduce flavoured e-cigarette use.

It cannot go without notice that the entire sample population should not be able to purchase tobacco products following the 2019 T21 amendment,²⁹ which raised the federal minimum age to purchase tobacco products from 18 years to 21 years.²⁹ While T21 precedes the data collection, we did not observe any significant changes in how past 30-day vapers obtained their products (themselves vs someone else got it for them) or where they bought them if they bought their products themselves (vape shop vs retail store) that would suggest age-based changes in restriction of access. Therefore, it appears that those under 21 years of age are still able to purchase tobacco products themselves, and some retailers, such as vape shops, may not be complying with the flavour restriction. The Office of NYS Attorney General Letita James issued a press release in December 2020 that discussed the 47 cease-and-desist letters issued to retailers across the state who were selling products to those under 21 years, restricted flavours, and were selling flavoured liquid to add to their own vaping products.³⁰ However, it seems that little enforcement has been done since, potentially due to reallocating of resources for the COVID-19 pandemic. Boots-on-the-ground efforts are important to enforce the NYS e-cigarette flavour restriction in the retail setting. Future assessments should assess areas of non-compliance.

Although this analysis is one of the first to assess the association between the NYS e-cigarette flavour restriction on youth tobacco product use, availability of e-cigarette products and consumer perceptions using a representative data source that oversampled NYS youth, there are some limitations to note. First, data are cross-sectional, so temporality cannot be inferred, and it is generally difficult to parse out the relative contributions of contemporaneous effects. Second, data are self-reported and subject to recall bias. Third, the data were collected using a web-based survey, so access to a device with internet access may limit participation in the survey. Fourth, the assessment of e-cigarette flavour use was done with a 'Check all that apply' question; therefore, we are unable to determine if flavours are being used separately or concurrently. Finally, this ITC Youth Survey did not assess the association of EVALI or Tobacco 21 and vaping use behaviour. Future studies should try to better disentangle the association of contemporaneous events and vaping behaviour.

This study found that nearly all past 30-day vapers continued to use non-tobacco-flavoured e-cigarettes following a state-wide e-cigarette flavour restriction; therefore, it is important to continue monitoring changes in user behaviours and perceptions, as well as retailer compliance with the policy. Overall, the use of e-cigarettes decreased during the 2-year period among youth in NYS, which may reflect the national decrease in youth e-cigarette use. However, increased enforcement and compliance to the NYS flavour restriction could result in a greater decrease of youth e-cigarette use. Further, a more comprehensive policy (eg, including other flavoured nicotine products; implementation of a nationwide restriction) would lead to a greater reduction in access to appealing nicotine products, such as

e-cigarettes, and likely reduce the switching or substituting with another flavoured product.

This analysis contributes to the evidence base available to public health officials to better understand perceptions, use patterns and access at the individual level to inform future enforcement and restrictions. While demographic characteristics and user behaviours may differ, other localities, states and nations considering the adoption of a flavour restriction on e-cigarettes can learn from these findings. Future studies should continue to monitor perceptions, use patterns and access at the individual level, retail level and population level to inform future enforcement and restrictions, especially as enforcement increases and other policies are implemented.

Contributors LMS was the guarantor and responsible for primary conceptualisation of the analysis, carried out the initial analysis, drafted the initial manuscript and reviewed and revised the manuscript. DH designed the data collection instruments, was responsible for funding acquisition, supervised data collection and critically reviewed the manuscript for important intellectual content. KAK and ROC critically reviewed the manuscript for important intellectual content. All authors participated in developing the concept and design of this study, analysis and interpretation of data, drafting or revising of the manuscript, approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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Competing interests The authors declare that they do not have competing financial interests or personal relationships that could have influenced the work reported in this presentation. DH has served as an expert witness on behalf of governments in litigation involving the tobacco industry.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by the University of Waterloo Research Ethics Committee ORE#21847/31017. Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data may be obtained from a third party and are not publicly available.

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