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## E-cigarette devices, brands, and flavors attract youth: Informing FDA's policies and priorities to close critical gaps

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### Abstract

**Purpose:** Identify e-cigarette devices, brands, and flavor types used by adolescents and young adults soon after the enactment of flavor restrictions, youth access laws, FDA's enforcement prioritization against some flavored pod/cartridge-based e-cigarettes, and during COVID-19 pandemic-related school closures.

**Methods:** National cross-sectional online survey (N = 4,351) in May 2020 assessed popularity, ever- and past-30-day use of e-cigarette device types (pod/cartridge-based, disposables, others), brands, flavor types and flavor-enhancers, by age group (under age 21 and 21 and over).

**Results:** While pod/cartridge-based e-cigarettes had the highest ever-use (82.7% <21; 69.8% 21) and were most often-used (41.9% <21; 41.4% 21), most past 30-day-users (50.8% <21; 61.9% 21) and 7-day-users (36.0% <21; 56.7% 21) used disposables. Mint/menthol was the most-used flavor type (pod/cartridge-based: 48.2% <21, 48.1% 21; disposables: 51.6% <21, 56.4% 21), followed by fruit (pod/cartridge-based: 37.4% <21, 35.5% 21; disposables: 51.6% >21, 46.2% 21), and sweet/dessert/candy flavor types (pod/cartridge-based: 24.4% <21, 24.7% 21; disposables: 29.7% <21, 33.8% 21). Participants reported using add-on e-cigarette flavor-enhancers (pod/cartridge-based: 24.6%; disposables: 31.3%).

**Conclusion:** Soon after FDA's January 2020 announcement of prioritized enforcement against flavored pod/cartridge-based e-cigarettes and during the pandemic lockdown, adolescents' and young adults' past 30-day use included mostly flavored disposables rather than pod/cartridge-based e-cigarettes, mint/menthol flavors, and some used add-on flavor enhancers. To reduce youth use, comprehensive regulation of e-cigarette devices and flavors should be enacted and enforced at federal, state, and local levels.

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#### Author contributions

SMG and BHF conceptualized and designed the study aims and methods, and managed data collection. SMG conducted the analyses and wrote the initial draft of the manuscript, with inputs from LKL and BHF. All authors (SMG, LKL, KM, and BHF) reviewed and edited the manuscript, and approved the final version. All authors have provided a Statement of Authorship.

#### Declaration of Competing Interest

Dr. Halpern-Felsher is a paid expert scientist in some e-cigarette litigation and an unpaid scientific advisor and expert regarding some tobacco-related policies. All other authors (Dr. Shivani Mathur Gaiha, Lauren Kass Lempert, and Dr. Karma McKelvey) have nothing to disclose.

## Keywords

E-cigarettes; Adolescents; Young adults; Pod/cartridge; Disposable; Flavor; Flavor-enhancer; Brand; Regulation; Restriction; FDA

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## 1. Introduction

Studies across the globe show a growing number of adolescents and young adults experimenting with and using electronic cigarettes (e-cigarettes) (Babineau et al., 2015; Cullen et al., 2019; Kong et al., 2017; Lee et al., 2014; Smith et al., 2019; Soteriades et al., 2020; Surís et al., 2015; Wang et al., 2015, 2020; White et al., 2015; Wills et al., 2016), including among never-users of combustible cigarettes (Babineau et al., 2015; Lee et al., 2014; Wang et al., 2015; Wills et al., 2016). E-cigarette manufacturers use strategies such as flavors and marketing to attract youth to new device types, brands, and flavor types. Of note, in 2015 JUUL introduced pod/cartridge-based e-cigarettes, which had taken over 75% of the entire US e-cigarette market by 2018 (Truth Initiative, 2018). JUUL has been criticized for its marketing, especially on social media, that uses youthful models, its availability in many flavors, a salt-based nicotine formulation that reduces the harshness and allows users to inhale higher levels of nicotine more easily, and its ability to be used without others noticing, all factors that appeal to youth (Chen-Sankey et al., 2020; Ickes et al., 2020; Keamy-Minor et al., 2019; Kong et al., 2019; Leavens et al., 2019; McKelvey et al., 2018; Ramamurthi et al., 2019; Truth Initiative, 2018). In response to pressure from the US Food and Drug Administration (FDA) and research showing rising numbers of adolescents initiating tobacco use through flavored pod/cartridge-based e-cigarettes (Barrington-Trimis & Leventhal, 2018; Gaiha & Halpern-Felsher, 2020; McKelvey et al., 2018), JUUL stopped selling its flavored pods/cartridges (except mint, menthol, and tobacco flavors) from brick-and-mortar stores in November 2018 and online in November 2019 (Kaplan et al., 2018; Kaplan & Sales, 2019), removed mint flavors in November 2019 (Perrone, 2019), and shut down their social media accounts (Kaplan et al., 2018), but meanwhile modified its design and firmware (Etter, 2020).

In January 2020, FDA issued guidance that it would prioritize enforcement against the following types of e-cigarette products that do not have premarket authorization: (1) flavored “cartridge-based” e-cigarette products (defined by the FDA as products with an enclosed cartridge or pod for e-liquids, e.g., JUUL); (2) products for which the manufacturer has not taken adequate measures to prevent minors’ access; and (3) products that target or promote use by minors (Food and Drug Administration, 2020). In its press release announcing this policy (United States Department of Health & Human Services, 2020), FDA stated it was prioritizing enforcement against “the products that are most widely used by children” and that it relied on data from the 2019 National Youth Tobacco Survey (NYTS) (Cullen et al., 2019) showing the majority of youth preferred cartridge-based e-cigarette products and the 2019 Monitoring the Future (MTF) survey (Leventhal et al., 2019) showing that “relatively low numbers of youth” use menthol- and tobacco-flavored products. Explicitly exempted from FDA’s enforcement prioritization were tobacco- and menthol-flavored products and “self-contained, disposable products” (Food and Drug Administration, 2020). FDA’s

enforcement prioritization that explicitly excluded disposable e-cigarettes coincided with rising popularity among youth of flavored disposable e-cigarettes (such as Puff Bar) and add-on flavor-enhancers (such as Puff Krush, an attachment to add flavor to e-cigarettes); these new products represent a potential new wave of unregulated e-cigarette products that attract youth (Cwalina et al., 2020; Delnevo et al., 2020; Hemmerich, 2020; Williams, 2019).

Since FDA's January 2020 announcement, data on preferred product and flavor types used by middle and high school students are available from the NYTS 2020 survey, which collected data from January to March 2020 (Wang et al., 2020), and the NYTS 2021 survey, which collected data from January to May 2021 (Park-Lee et al., 2021). Both NYTS 2020 and 2021 data showed an increase in adolescent past-30-day use of disposable e-cigarettes, with disposables becoming the most commonly used device type in the past 30 days by adolescents in 2021 (Park-Lee et al., 2021; Wang et al., 2020). The NYTS 2020 and 2021 data showed that fruit was the most widely used flavor type among adolescent past-30-day e-cigarette users, and mint/menthol as a combined flavor category was the most widely used in pod/cartridge-based e-cigarettes, followed by sweet, dessert, or candy flavors (Park-Lee et al., 2021; Wang et al., 2020).

The FDA's limited enforcement prioritization was intended to have rendered fruit, mint, sweet, dessert, and candy flavors unavailable in pod/cartridge-based e-cigarettes; however, no data are available on flavor types used in pod/cartridge-based or disposable devices a few months after FDA's announcement. School closures due to the COVID-19 pandemic put an end to NYTS 2020 data collection after March 2020, leaving a temporal gap in our understanding of what products youth were using in the Spring of 2020, including what products youth were using soon after the FDA's January 2020 announcement and during school closures due to the COVID-19 pandemic. Further, neither the NYTS, MTF, nor any other published data examine whether specific e-cigarette device types, brands, and flavor types used differ between youth under the legal age of sale of tobacco in the US (i.e., under 21 years) (Further Consolidated Appropriations Act, 2019) and young adults (ages 21–24), especially following the January 2020 FDA announcement and during the early months of the pandemic. In addition, NYTS and other studies do not include detailed information on add-on flavor-enhancers that allow flavors to be added to e-cigarette devices that are being sold in tobacco- and menthol-flavors, but not fruit, mint, or sweet/dessert/candy flavor types.

This national study aims to fill gaps in the literature and characterize the e-cigarette product landscape by assessing both adolescent and young adult use of specific e-cigarette device types, flavor types, and brands in the US since FDA's actions and some companies' self-imposed sales restrictions on some flavor types. We address 3 research questions among a group of 13–24-year-olds: (1) Among e-cigarette users, which specific e-cigarette device types are in use, ever and in the past 30- and 7-days, and which brands were ever used? (2) Among e-cigarette users, what flavor types and flavor-enhancers are currently in use? and (3) Which e-cigarette brands are the most popular? Our findings provide insight into patterns of adolescent and young adult e-cigarette use (stratified as under 21 years and 21 and above) that can help inform FDA's enforcement priorities as well as the development of effective e-cigarette regulations in the US. Additionally, these findings, and knowing which specific device types, flavor types, and brands adolescents and young adults were using soon

after enforcement prioritization, are important and timely to help inform FDA's ongoing consideration of premarket tobacco product applications (PMTAs) for e-cigarettes.

## 2. Methods

### 2.1. Participants and procedures

We conducted a national, cross-sectional online survey from May 6 to May 14, 2020 using convenience sampling. Qualtrics, an internet-based survey administration and management service, maintains online panels, comprising people who agree to participate in surveys. Participants in this study were recruited from these online panels through an email link to the survey that they received via social media, gaming sites, customer loyalty portals, and website intercept recruitment. All participants provided informed consent and assent online after clicking the link. Additional details on study recruitment are provided elsewhere (Gaiha et al., 2020a; Gaiha et al., 2020b). We purposely sampled an equal proportion of adolescents (13–17 years old), young adults below legal tobacco-sales age (18–20 years old) and young adults above legal tobacco-sales age (21–24 years old), and an equal proportion of ever- and never-e-cigarette users. Qualtrics balanced our sample to include proportions of sex and race/ethnicity similar to the US Census. Our sample included 4,351 participants, of whom 2,167 were e-cigarette users who answered specific questions about products used. Qualtrics ensures that the quality of survey responses meets ESOMAR standards for social and behavioral research (Qualtrics, 2014). This study followed the American Association for Public Opinion Research (AAPOR) reporting guidelines for survey studies (The American Association for Public Opinion Research, 2016). This study was approved by the Institutional Review Board at Stanford University.

### 2.2. Measures

Our survey included validated and newly-developed items, based on inputs from our Youth Advisory Board (12 youth members aged 16–22). We pilot-tested the survey among a small group of researchers and our Youth Advisory Board to finalize questions.

**2.2.1. Socio-demographics**—Socio-demographic information was collected on age, sex, sexual orientation, race/ethnicity, US state of residence, and mother's educational attainment. Other studies show that these variables are associated with tobacco use or susceptibility to use e-cigarettes (Garcia et al., 2021; Soneji et al., 2019).

**2.2.2. E-cigarette Use: Ever-use, past 30-day use, past 7-day use, and future use of specific e-cigarette products**—We provided all participants with text and accompanying images describing disposable, pod/cartridge-based, and other e-cigarette products. Then we asked participants “Have you ever used any of these products in your entire life, even 1 or 2 puffs?” (Yes/No) for each of the following products: (1) Disposable vapes like Puff Bar or FOGG, (2) Pod/cartridge-based vapes like JUUL or Suorin, and (3) any other vapes like mods. Participants who indicated ever using any of the products above were asked questions corresponding to each product, including the number of days they used the product in the last 30 days (from 0 to 30) and the last 7 days (from 0 to 7). Participants who indicated use of any combination of products above (disposable and pod/cartridge-

based; pod/cartridge-based and other; disposable and other; disposable, pod/cartridge-based, and other), were asked, “Which best describes the vape you use most often?” with 5 response categories: (1) Disposable vape like Puff Bar; (2) Pod/cartridge-based vape like JUUL; (3) any other vape like mods; (4) don’t know; (5) other, please specify (adapted from measures in NYTS 2020) (Wang et al., 2020; Centers for Disease Control and Prevention, 2020). Participants indicating use of any device type were asked, “Have you ever used Puff Krush or other flavored add-on pod attachments for your pre-filled devices?” (Yes/No) and “How likely is it that over the next 6 months you will use (disposable; pod/cartridge-based; other) vapes again?” with a 4-point Likert-type scale: (1) very unlikely; (2) somewhat unlikely; (3) somewhat likely; (4) very likely. All responses except “very unlikely” were collapsed into one variable, “likely,” since any response other than “very unlikely” indicates the absence of a firm resolve not to use in the future (Nicksic & Barnes, 2019).

**2.2.3. Specific e-cigarette brands used**—Participants who answered “Yes” to having ever used disposable vapes were asked which brands they had ever used, with 8 response categories: i) Puff Bar, ii) VGod Stig, iii) Posh, iv) Mojo, v) Fogg, vi) Unicorn, vii) Halo, and viii) other, please specify. Participants who answered “Yes” to having ever-used pod-based vapes were asked which brands they had ever used, with 7 response categories: i) JUUL, ii) Phix, iii) Smok, iv) Suorin, v) Stiizy, vi) Myblu, and vii) other, please specify. Participants who answered “Yes” to having ever-used any other e-cigarettes were asked to indicate the type of e-cigarette used from 8 response categories: i) mods, ii) single-use vapes that look like cigarettes, iii) rechargeable cigarette-shaped, iv) larger than a cigarette, v) large size tank, vi) hookah pen, vii) vape pen, or viii) other, please specify (allowing for multiple selections). Brands and device categories were adapted from a study among young adults (McKelvey et al., 2019).

**2.2.4. Flavor types**—We asked e-cigarette ever-users of each device type (disposable e-cigarettes, pod-based e-cigarettes, and other e-cigarettes), “What flavor did you use in your [(disposable; pod/cartridge-based; other) vape] in the past 30 days?” with 14 response categories: (1) tobacco flavored, (2) mint, (3) menthol, (4) wintergreen, (5) fruit (e.g., mango, cherry, blueberry, strawberry, watermelon, coconut), (6) coffee or tea (coffee or any related flavor, e.g., espresso, latte, cappuccino), (7) sweet or dessert flavors (e.g., crème or crème brulee, caramel, vanilla, chocolate, ice cream, mud pie), (8) Spice (e.g., clove, cinnamon, nutmeg), (9) alcohol (e.g., wine, bourbon, rum, brandy, tequila, whiskey, beer, mai-tai, daiquiri), (10) candy, (11) other beverage (e.g., Coca-Cola), (12) unflavored, (13) other, please specify, and (14) don’t know/don’t remember (Cullen et al., 2019; Leventhal et al., 2019; McKelvey et al., 2018; Nguyen et al., 2019; Schneller et al., 2019; Wang et al., 2020). As a response to (13) other flavor, if participants indicated that they used an ‘ice’ flavor (e.g., cooling ice, lush ice), we coded it as menthol. Since cooling flavors have been associated with greater frequency of e-cigarette use among high school students (Davis et al., 2021), we grouped all flavors with a cooling sensation, including mint, menthol (including ice from the “other” category), and wintergreen, into a single “mint/menthol” flavor category. National surveys of tobacco use among youth (including the NYTS 2019) also group mint and menthol together in one “mint/menthol” flavor category (Cullen et al.,

2019). Next, we asked ever-users of add-on flavor-enhancers, “Which flavor do you use most often?”

**2.2.5. Popularity of e-cigarette products**—We asked all participants, “Before today, have you heard of these products?” (McKelvey et al., 2019; McKelvey et al., 2018) (similarly worded to a question about heated products in the NYTS 2020) (Davis et al., 2021). Participants could select multiple brands per device type: (1) disposable vapes, with 8 response categories, including i) Puff Bar, ii) VGOD Stig, iii) Posh, iv) Mojo, v) Fogg, vi) Unicorn, vii) Halo, and viii) other, please specify; (2) reusable pod-based vapes, with 7 response categories, including i) JUUL, ii) Phix, iii) Smok, iv) Suorin, v) Stiizy, vi) Myblu, and vii) other, please specify; and (3) other e-cigarettes or vapes, with 3 response categories: i) mods, ii) vapes that look like cigarettes, and iii) other, please specify. Next, participants were asked, “What is the most popular vaping product among your peer group at the moment?” adapted from frequently asked questions regarding e-cigarettes (Fadus et al., 2019). Participants could select only one brand corresponding to each device type.

### 2.3. Data analysis

We tabulated counts and percentages describing participant characteristics, ever-users, past 30-day users, past 7-day users, flavor types used by device type (disposable, pod/cartridge-based and other e-cigarettes), and participants having heard of different e-cigarette brands and identifying popular e-cigarette brands in their peer group. Chi-square tests were used to assess differences in proportion of participants who: (a) ever used pod/cartridge-based devices compared to disposable devices, (b) used pod/cartridge-based devices compared to disposable devices in the past 30 days, (c) ever used the top-two brands, and (d) used the top-two flavor types in the past 30 days. We conducted chi-square tests to assess differences between devices, brands, and flavors used by participants who were under age 21 and 21 years and above (i. e., the legal age of tobacco sales) for all the outcomes listed above. Listwise deletion was used to omit cases with missing data. We used 2-tailed tests to derive p-values and considered results statistically significant at  $p < 0.05$ ; Stata v15.1 was used. We analyzed data from all 4,351 participants for questions concerning number and/or percentage who have heard of e-cigarette brands and most popular brands among peer group (missing data on 36 participants) and a sub-group of 2,167 ever-users of e-cigarettes for other questions concerning use of specific e-cigarette device types, brands, and flavors. All results are presented by age group (<21 and ≥21).

## 3. Results

Among all those who accessed/clicked the survey link, 40% went on to complete the survey (survey completion rate); an additional 269 participants were removed for completing the survey in less than one-third the average time, resulting in a final sample of 4,351 participants. Table 1 summarizes participant characteristics overall, and by age group. Out of 4,351 survey participants, 66.9% were under 21 years old and among them, 50.1% were aged 13–17, 67.3% were female and 30.2% male, and 19.6% identified as LGBTQ. Participants aged ≥21 were 61.3% female and 37.2% male, and 14.5% identified as LGBTQ. Participants were from all US states.

### 3.1. E-cigarette device types and brands used

As shown in Table 2, among e-cigarette ever-users, 78.4% had used pod/cartridge-based e-cigarettes, 59.5% had used disposable e-cigarettes, and 56.8% had used other e-cigarettes like tanks and mods. However, among e-cigarette ever-users most had used disposable e-cigarettes compared to pod/cartridge-based or other e-cigarettes in the past 30 days (54.4% disposable; 45.3% pod/cartridge-based; and 40.1% other e-cigarettes) and past 7 days (42.7% disposable; 37.0% pod/cartridge-based; and 33.7% other e-cigarettes). Between pod/cartridge-based and disposable devices, a significantly higher proportion of pod/cartridge-based devices were ever used by participants compared to disposable products ( $\chi^2 = 87.62$ ;  $p < 0.001$ ) and in the past 30 days, a significantly higher proportion of disposable devices were used compared to pod/cartridge-based devices ( $\chi^2 = 310.19$ ;  $p < 0.001$ ).

Among ever e-cigarette users, the brands used most were JUUL among pod/cartridge-based e-cigarettes and Puff Bar among disposable e-cigarettes; vape pens were most commonly used among other e-cigarettes. Between the top 2 brands ever used, a significantly higher proportion of participants had ever used JUUL (85.9%) compared to Puff Bar (66.8%) ( $\chi^2 = 78.48$ ;  $p < 0.001$ ). The proportion of ever-users likely to use e-cigarettes in the next 6 months was the highest among disposable e-cigarette users (72.0%), followed by other e-cigarette users (63.8%), and pod/cartridge-based e-cigarette users (62.9%). Additional analysis showed that among 704 ever-users who indicated using multiple e-cigarette devices and who answered the question on product used most often, 41.8% used pod/cartridge-based e-cigarettes most often (41.9% < 21; 41.4% ≥ 21), 34.2% used disposables most often (34.4% < 21 and 33.9% ≥ 21), 7.7% used other e-cigarettes most often (7.1% < 21; 8.6% ≥ 21), and 16.3% did not know what product they used most often (16.5% < 21; 16.0% ≥ 21). The proportion of those who had used all 3 types of e-cigarettes (pod/cartridge-based, disposable and other e-cigarettes) was 38.8% among ever-users, 22.5% among past 30-day users, and 20.8% among past 7-day users.

Among 779 ever-users of pod/cartridge-based e-cigarettes who answered the question about use of add-on flavor-enhancers, 24.6% had used add-on flavor-enhancers with their pod/cartridge-based e-cigarette, and among 616 ever-users of disposable e-cigarettes who answered the question on use of add-on flavor-enhancers, 31.3% of disposable ever-users had used add-on flavor-enhancers with their disposable e-cigarettes. See Table 2 for details.

There were differences in e-cigarette devices and brands used between participants under and over the legal age to purchase these products. Compared to e-cigarette users who were 21 and above, significantly more e-cigarette users under 21 had ever used pod/cartridge-based e-cigarettes, especially JUUL, Suorin, and MyBlu (Table 2). Additionally, significantly more e-cigarette users under 21 had ever used Puff Bar and VGOD Stig disposable e-cigarette brands compared to e-cigarette users who were 21 and above. Among other e-cigarettes used, significantly more e-cigarette users under 21 had ever used vape pens and mods compared to e-cigarette users 21 and above. Compared to e-cigarette users under 21, significantly more e-cigarette users 21 and above reported past 30-day and past 7-day use of any e-cigarettes. However, the likelihood of using any e-cigarette device in the next 6 months did not differ between e-cigarette users under 21 and those 21 and above.

### 3.2. Use of flavors in e-cigarettes and add-on flavor-enhancers

Table 3 shows that mint/menthol, fruit, and sweet/dessert/candy flavors in pod/cartridge-based, disposable and other e-cigarettes are being used by participants, including those aged under 21 years. Among pod/cartridge-based and disposable e-cigarette users, mint/menthol flavors (including any use of mint, menthol, wintergreen, or ice) were the most used flavors in the past 30 days (pod/cartridge-based: 48.2% <21, 48.1% ≥21; disposable: 51.6% <21, 56.4% ≥21). The cumulative number of instances when participants used mint/menthol flavor types in the past 30 days was also higher than for other flavors (pod/cartridge-based: 382 (65.2%) <21, 193 (67.2%) ≥21; disposable: 320 (73.0%) >21, 186 (82.7%) ≥21). After mint, menthol-flavored products were the most used in the mint/menthol flavor type category in the past 30 days (pod/cartridge-based: 20.5% <21, 21.9% ≥21; disposable 21.2% <21, 30.2% ≥21). Across all products, 20 participants indicated that they had used ice flavors in the past 30 days, including “ice,” “ice flavors,” “cooling ice,” as well as some specific ice flavors with a fruit/sweet component like “grape ice” and “lush ice” which have a cooling/menthol component. Next were fruit (pod/cartridge-based: 37.4% <21, 35.5% ≥21; disposable: 51.6% >21, 46.2% ≥21) and sweet/dessert/candy flavors (pod/cartridge-based: 24.4% <21, 24.7% ≥21; disposable: 29.7% <21, 33.8% ≥21). Other e-cigarette users had used fruit flavors the most (22.7% <21, 24.6% ≥21), followed by mint/menthol (18.0% <21, 17.2% ≥21), and sweet/dessert/candy flavors (13.8% <21, 7.3% ≥21) in the past 30 days. Overall, 20.0% to 34.9% of e-cigarette users did not know which flavor they were using.

Between the top 2 flavors used, the proportion of participants using mint/menthol type flavors in the past 30 days was significantly higher than those using fruit flavors in disposables ( $\chi^2 = 9.46$ ;  $p = 0.002$ ) and pod/cartridge-based e-cigarettes ( $\chi^2 = 33.82$ ;  $p < 0.001$ ). Table 3 also shows that significantly more participants ≥21 and above compared to those under 21 had used menthol flavors in disposable devices ( $\chi^2 = 6.89$ ,  $p = 0.009$ ); tobacco flavor in both disposable ( $\chi^2 = 8.11$ ,  $p = 0.004$ ) and pod/cartridge-based devices ( $\chi^2 = 6.02$ ,  $p = 0.014$ ); alcohol flavors in pod/cartridge-based devices ( $\chi^2 = 5.75$ ,  $p = 0.016$ ); spice flavors in disposable devices ( $\chi^2 = 4.24$ ,  $p = 0.039$ ); and other beverage flavors like Coca-Cola in pod/cartridge-based devices ( $\chi^2 = 4.89$ ,  $p = 0.027$ ). Among 287 pod/cartridge-based e-cigarette users and 269 disposable users who used add-on flavor-enhancers, the flavors used most often were fruit (pod/cartridge-based: 46.7% <21, 50.5% ≥21; disposable: 43.9% <21, 44.7% ≥21), followed by mint/menthol (32.3% <21, 26.7% ≥21), and candy/sweet/dessert flavors (12.1% <21, 13.3% ≥21).

### 3.3. Popularity of e-cigarette brands

As shown in Table 4, 91.2% of youth had heard of JUUL, 86.1% said JUUL was the most popular brand among their peers, 60.8% had heard of the disposable e-cigarette brand Puff Bar, and 43.9% said Puff Bar was the most popular brand. Between the 2 most popular products, a significantly higher percentage of all participants (users and non-users) had heard of JUUL compared to Puff Bar ( $\chi^2 = 84.18$ ,  $p < 0.001$ ), and JUUL remained more popular among peer groups compared to Puff Bar ( $\chi^2 = 34.41$ ,  $p < 0.001$ ). In comparison to JUUL, other pod/cartridge-based brands such as Suorin, MyBlu, Phix, and Stiizy were heard of much less. Similarly, compared to Puff Bar, other disposable brands such as VGOD Stig, Mojo, Posh, Fogg, Halo, and Unicorn were heard of much less. Few participants indicated



that other brands of pod/cartridge-based e-cigarettes and disposables were popular in their peer groups, with <6% reporting other pod/cartridge-based brands were popular and <11% saying that other disposable brands were popular. Table 4 shows that there was no significant difference in specific brands that participants had heard about or most popular brands in their peer group by age group (<21 vs ≥21).

#### 4. Discussion

This cross-sectional study provides data on the specific e-cigarette device types, brands, and flavor types adolescents and young adults were using soon after FDA's January 2020 announcement to prioritize enforcement against flavored pod/cartridge-based e-cigarettes. Notably, this study fills gaps in the timeline of evidence presented in the NYTS 2020 (Wang et al., 2020) and NYTS 2021 (Park-Lee et al., 2021) and adds a group of young adults for comparison with those under 21 years. Our findings demonstrate that FDA's actions that excluded from its enforcement priorities flavored disposable e-cigarettes and menthol-flavored pod/cartridge products have not gone far enough to prevent youth e-cigarette use. Our findings show that an alarming percentage of youth are using flavored disposables as well as still using flavored pod/cartridge-based products and that mint and menthol flavors (including spearmint, wintergreen, and ice) are among the most popular flavor types used by youth. These findings should help inform FDA's decisions on PMTAs from e-cigarette companies seeking authorization to market flavored e-cigarette products.

First, in contrast to the 2019 NYTS data and MTF data the FDA relied on to exempt flavored disposables from its enforcement priorities (Cullen et al., 2019; Leventhal et al., 2019), our survey conducted several months into the period of FDA prioritizing enforcement against flavored pod/cartridge-based products shows that more adolescents and young adults used disposable e-cigarettes in the past-30- and 7-days compared to pod/cartridge-based e-cigarettes (although pod/cartridge-based e-cigarettes had the highest rates of ever-use). Although NYTS 2020 data showed a 1000% and 400% increase in use of disposable e-cigarettes from 2019 to 2020 among high school and middle school-aged adolescents, respectively, pod/cartridge-based e-cigarettes were still the most commonly used device type (Wang et al., 2020). Our findings from May 2020 are consistent with the 2021 NYTS data showing that disposable e-cigarettes were the most widely used device type among past 30-day users. It is likely that adolescents and young adults began migrating towards disposables when they found that their preferred flavors were no longer available in pods/cartridges. Such migration is likely directly related to FDA prioritizing enforcement against flavored pod/cartridge-based products, but not against flavored disposable e-cigarettes. It is also not surprising that adolescents and young adults are using disposables given that manufacturers of new disposables use similar strategies as pod/cartridge-based e-cigarette manufacturers, including marketing directly to youth and selling products in multiple flavors, concealable shapes and sizes, and setting lower prices (Rainer & Lever, 2020), with the added convenience that customers need not refill or replace pods or cartridges (Delnevo et al., 2020; Rainer & Lever, 2020; Williams, 2019).

Second, mint/menthol, fruit, and sweet/candy/dessert flavors are the most commonly used in both pod/cartridge-based and disposable e-cigarettes, consistent with the 2020 and

2021 NYTS results if mint and menthol were combined as one category (Wang et al., 2020). Our findings show that 20.5% of youth under 21 used menthol pod/cartridge-based e-cigarettes in the past 30 days, relatively higher than in a study cited by FDA to justify excluding menthol from its enforcement priorities where 5.9% of 12th graders used menthol (Leventhal et al., 2019). Other studies have used sales-related data to show that following FDA's 2020 announcement prioritizing enforcement against some flavors, menthol-flavored e-cigarettes cornered 82.8% of the entire US e-cigarette market share (including among adolescents, young adults, and adults) (Diaz et al., 2020), and by May 2020, menthol (61.8%) and tobacco (37.1%) flavors dominated the market (Ali et al., 2020). It is plausible that after our study data were collected and a year since FDA's limited enforcement prioritization, non-menthol/non-tobacco flavored disposable e-cigarettes became even more widely available, which may explain why fruit flavor types were observed as the most commonly used flavor category overall and in disposable e-cigarettes in the past 30 days in the NYTS 2021 data (Park-Lee et al., 2021). In addition to cooling flavor types being associated with higher frequency of youth use (Davis et al., 2021), a recent study suggested that youth may interchange mint and menthol products to achieve a "minty" flavor, given that menthol was found to be the dominant flavor chemical in both mint- and menthol-flavored pod/cartridge-based and disposable e-cigarettes (Omaie et al., 2021). Moreover, participants in our study reported using new "ice flavors" across e-cigarette devices; these flavors contain mint, menthol, and fruit ingredients regardless of the name. Thus, manufacturers can evade flavor restrictions (Hemmerich et al., 2020) without removing mint/menthol and fruit ingredients just by using "concept flavor" names (e.g., "Lush Ice," "O.M.G" [Orange, mango and guava]) and associated packaging which can contribute to the appeal of tobacco products (Erinoso et al., 2021). We also show that add-on flavor enhancers like Puff Krush enable youth to use flavors in any e-cigarette, including so-called "tobacco-flavored" or "unflavored" e-cigarettes which are not subject to FDA's flavor standard (Family Smoking Prevention and Tobacco Control Act, Section 907, 2009) or limited enforcement prioritization (Food and Drug Administration, 2020).

These findings demonstrate the widespread and growing use of menthol and menthol-based flavors and support the need to remove the exemption for menthol-flavored products from FDA's enforcement priorities (Food and Drug Administration, 2020) and tobacco product standards (Family Smoking Prevention and Tobacco Control Act, Section 907, 2009). The findings also support prioritizing enforcement against flavored disposables and add-on-flavor enhancers, and regulating flavor ingredients, rather than flavor names or industry-chosen names (Hemmerich et al., 2020). FDA's April 29, 2021 announcement (US Food and Drug Administration, 2021) that it intends to initiate a rulemaking to prohibit menthol as a "characterizing flavor" in cigarettes and menthol and other flavors in cigars does not address flavors in e-cigarettes and does not prevent manufacturers from adding menthol or other flavors to their tobacco products and then marketing them with new names (e.g., "Green" or "Ice") to evade restrictions. To address gaps in federal regulation, states such as Massachusetts (Commonwealth of Massachusetts Department of Public Health. Guide, 2019) and cities like San Francisco (San Francisco Health Code, 2018) have enacted local restrictions on flavored e-cigarettes, and other states and localities may adopt similar laws to prevent youth use.

Finally, we found that pod/cartridge-based e-cigarettes, and JUUL in particular, were the most popular, experimented with, and most often used products including among youth under 21. Our data show that even after JUUL's self-imposed flavor reductions and 5 months after FDA's announced enforcement prioritization against some flavored pod/cartridge-based e-cigarettes, we continue to see a sizable proportion of youth under 21 using JUUL. Despite US law prohibiting e-cigarette sales to underage minors (Further Consolidated Appropriations Act, 2019) and COVID-19-related stay-at-home mandates when minors' access and use of e-cigarettes may have decreased (Gaiha et al., 2020b), widespread use of devices and brands by adolescents under 21 shows that underage use remains a problem. FDA should uncompromisingly enforce against all e-cigarette manufacturers and retailers who do not take adequate measures to prevent minors' access. Age-appropriate prevention efforts for both adolescents and young adults may be developed to provide updated terminology, product descriptions, images, and corresponding health effects of e-cigarette devices, brands and flavors commonly used.

#### 4.1. Limitations

As this survey uses a self-reported convenience sample, we cannot generalize our findings to the entire population of youth using e-cigarettes in the US. Data presented in this study were unweighted. However, our sample was balanced on sex and race/ethnicity as per census data and provides data on patterns of use from a national sample. Our survey did not ask participants to reflect on their use of particular e-cigarette products before and after key e-cigarette-related FDA regulations. Our study findings cannot be used to establish a causal relationship between FDA's enforcement prioritization and e-cigarette devices, brands, and flavor types used. Longitudinal studies that collected data pertaining to e-cigarette use before and after FDA regulation should be conducted to provide more information on these precise shifts in product use patterns and to assess correlations. Our survey also did not examine which devices participants initiated with or record progression from one device type to another (between ever-use and past-30-day use) or ask participants for reasons for such shifts. Further, our survey did not include all e-cigarette brands. For example, we did not include Vuse, a brand that has gained popularity. The NYTS 2021 data showed that Vuse has become the second most popular brand after Puff Bar among high school past 30-day e-cigarette users (Park-Lee et al., 2021). We also did not ask about brands used in the past 30 days as was asked in the NYTS 2021 (Park-Lee et al., 2021). Finally, we may have had limited users indicating use of ice flavor types because we did not list 'ice' as its own flavor category and relied on an open-ended, text-entry option. Since our study, ice flavors have become dramatically more popular (Leventhal et al., 2021).

## 5. Conclusions and Implications for tobacco regulation

Our findings call for the urgent attention of the FDA to be cognizant of youth migrating to e-cigarette products that are not effectively regulated, such as disposable e-cigarettes, menthol-, and mint-flavored e-cigarettes that may be called "menthol" to avoid restrictions, add-on flavor-enhancers, and new names of flavors (e.g., "ice") that can escape regulations on restricted flavors.

FDA's regulatory actions have generally lagged behind the current realities of youth tobacco use (Berman & Jenson, 2020). Our findings suggest that to meet its promise to "do everything possible" to stop the "public health crisis that is affecting children, families, schools and communities," (Food and Drug Administration, 2020), FDA should formally revise its enforcement prioritization guidance to remove the exemptions for disposable e-cigarettes and menthol-flavored products (including "ice" and related concept names) to better protect youth. FDA has acknowledged that scientific review of new products is a critical component of its mission to protect the public (Food and Drug Administration, 2020) and especially youth from tobacco-related harms and nicotine addiction (American Academy of Pediatrics, 2020). In reaching a determination about whether to grant marketing authorization, FDA is required to find that the product is "appropriate for the protection of the public health," taking into consideration the likelihood that youth will initiate tobacco use with the product (Family Smoking Prevention and Tobacco Control Act, Sec 910(c)(4), 2009). When reviewing PMTAs for e-cigarettes (Halpern-Felsher et al., 2020), FDA should not authorize the marketing of any e-cigarette product, device, or enhancer whose flavors and characteristics appeal to youth because these product features make it more likely that youth will initiate or continue tobacco use, with unproven cessation benefits for adults (Hedman et al., 2021), rendering the product not appropriate for the protection of the public health. Additionally, FDA should not authorize any product whose manufacturer has not provided evidence that their steps to prevent youth use have actually reduced youth use of e-cigarettes (Halpern-Felsher et al., 2020).

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**Implications and contribution**

We lack recent data on youth use of e-cigarette devices, brands and flavors since imposed restrictions on tobacco sales to people <21 years, some flavors and flavored cartridge-based-e-cigarettes. Flavored disposables and mint/menthol-flavors are widely used by youth, suggesting that more comprehensive regulation is still needed to limit e-cigarette use.

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**Table 1**

Participant characteristics, overall and by legal age of tobacco purchase, no. (%).

	Total sample (N = 4,351)	Under age 21 (N = 2,885)	Age 21 and above (N = 1,430)
Age (N = 4,315)			
13–20	2885 (66.9)	2885 (100.0)	–
21–24	1430 (33.1)	–	1430 (100.0)
Sex (N = 4,314)			
Male	1402 (32.5)	870 (30.2)	532 (37.2)
Female	2816 (65.3)	1940 (67.3)	876 (61.3)
Non-binary/Other	96 (2.2)	74 (2.6)	22 (1.4)
LGBTQ (N = 4,310)			
Yes	773 (17.9)	566 (19.6)	207 (14.5)
No	3537 (82.1)	2314 (80.3)	1223 (85.5)
Race/ethnicity (N = 4,315)			
AA/Black, non-Hispanic	598 (13.8)	390 (13.5)	208 (14.6)
Asian/ Native Hawaiian or Pacific Islander, non-Hispanic	207 (4.8)	132 (4.6)	75 (5.2)
Hispanic, non-AA/black	657 (15.2)	453 (15.7)	204 (14.3)
Other/multiracial, non-Hispanic	263 (6.1)	178 (6.2)	85 (5.9)
White, non-Hispanic	2590 (60.0)	1732 (60.0)	858 (60.0)
US region (N = 4,299)			
Northeast	902 (21.0)	589 (20.5)	313 (22.0)
Midwest	911 (21.2)	632 (21.9)	279 (19.6)
South	1495 (34.8)	981 (34.1)	514 (36.2)
West	981 (22.8)	669 (23.2)	312 (22.0)
U.S. Territories	10 (0.2)	7 (0.2)	3 (0.2)
Mother's education (N = 4,298)			
Completed high school or below	986 (22.9)	489 (49.0)	509 (51.0)
Started college	601 (14.0)	292 (47.9)	317 (52.0)
Completed college (2- or 4-year degree)	1420 (33.0)	742 (51.8)	690 (48.2)
Graduate or professional degree	883 (20.5)	425 (48.0)	460 (52.0)
Don't know	408 (9.5)	210 (51.2)	200 (48.8)
E-cigarette ever users (N = 4,315)	2167 (50.2)	1442 (49.9)	725 (50.7)

Note: Due to missing data, percentages reported out of number of responses.

**Table 2**

E-cigarettes and brands used among ever-users, overall and by age, no. (%\*).

No. of responses	Total sample of e-cigarette users (N = 2,167)	Under age 21 (N = 1,442)	Age 21 and above (N = 725)	p-value
<b>Specific products ever used</b>				
Pod/cartridge-based (N = 2,148)	1,684 (78.4)	1,183 (82.7)	501 (69.8)	<0.001
Disposables (N = 2,138)	1,273 (59.5)	859 (60.5)	414 (57.6)	0.188
Other (N = 2,140)	1,215 (56.8)	794 (55.8)	421 (58.6)	0.217
Flavor-enhancer in pod/cartridge-based device (N = 779)	192 (24.6)	126 (23.6)	66 (26.9)	0.315
Flavor-enhancer in disposable device (N = 616)	193 (31.3)	123 (30.2)	70 (33.5)	0.407
<b>Past 30-day use among ever-users</b>				
Pod/cartridge-based (N = 1,677)	759 (45.3)	470 (39.9)	289 (57.8)	<0.001
Disposables (N = 1,268)	690 (54.4)	435 (50.8)	255 (61.9)	<0.001
Other (N = 1,212)	486 (40.1)	258 (32.6)	228 (54.3)	<0.001
<b>Past 7-day use</b>				
Pod/cartridge-based (N = 1,675)	619 (37.0)	371 (31.5)	248 (49.7)	<0.001
Disposables (N = 1,266)	541 (42.7)	308 (36.0)	233 (56.7)	<0.001
Other (N = 1,207)	407 (33.7)	205 (26.0)	202 (48.2)	<0.001
<b>Ever-users likely to use in the next 6 months</b>				
Pod/cartridge-based (N = 1,641)	1,033 (62.9)	708 (61.6)	325 (66.1)	0.088
Disposables (N = 1,252)	902 (72.0)	609 (72.0)	293 (72.2)	0.947
Other (N = 1,177)	747 (63.8)	477 (62.2)	270 (66.8)	0.116
<b>Specific e-cigarette brands ever used</b>				
Pod/cartridge-based e-cigarettes (N = 1,648)				
JUUL	1,415 (85.9)	1,029 (88.9)	386 (78.6)	<0.001
Suorin	445 (27.0)	346 (29.9)	99 (20.2)	<0.001
Smok	425 (25.8)	307 (26.5)	118 (24.0)	0.288
Phix	199 (12.1)	135 (11.7)	64 (13.0)	0.436
MyBlu	192 (11.6)	111 (9.6)	81 (16.5)	<0.001
Stiizy	190 (11.5)	125 (10.8)	65 (13.2)	0.157
Disposable e-cigarettes (N = 1,252)				
Puff Bar	837 (66.8)	630 (74.5)	207 (51.0)	<0.001
VGOD	377 (30.1)	274 (32.4)	103 (25.4)	0.011
Mojo	150 (12.0)	78 (9.2)	72 (17.7)	<0.001
Posh	148 (11.8)	82 (9.7)	66 (16.3)	<0.001
Fogg	140 (11.2)	73 (8.6)	67 (16.5)	<0.001
Halo	83 (6.6)	40 (4.7)	43 (11.0)	<0.001
Unicorn	77 (6.1)	39 (4.6)	38 (9.4)	<0.001
Other e-cigarettes (N = 1,170)				
Vape pens	658 (56.2)	462 (60.5)	196 (48.3)	<0.001
Mods	365 (31.2)	261 (34.2)	104 (25.6)	0.003

No. of responses	Total sample of e-cigarette users (N = 2,167)	Under age 21 (N = 1,442)	Age 21 and above (N = 725)	p-value
Rechargeable cigarette-shaped	328 (28.0)	188 (24.6)	140 (34.5)	<0.001
Large size “tank”	313 (26.7)	190 (24.9)	123 (30.3)	0.046
Single-use, looking like cigarettes	315 (26.9)	164 (21.5)	151 (37.2)	<0.001
Larger than a cigarette	251 (21.4)	145 (19.0)	106 (26.1)	0.005
Hookah pens	213 (18.2)	92 (12.0)	121 (29.8)	<0.001

Note: Due to missing data, percentages reported out of number of responses. P-values < 0.05 indicate significant differences between participant responses under 21 and 21 and above.

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**Table 3**

E-cigarette flavor types used in the past 30 days, by device type and age, no. (%).

	Pod/cartridge-based (N = 872)		Disposable Bar (N = 663)		Other e-cigarettes (N = 659)		Add-on flavor enhancer with pod-/cartridge-based <sup>c</sup> (N = 287)		Add-on flavor enhancer with disposable <sup>c</sup> (N = 269)	
	Under age 21 (N = 585)	Age 21 and above (N = 287)	Under age 21 (N = 438)	Age 21 and above (N = 225)	Under age 21 (N = 427)	Age 21 and above (N = 232)	Under age 21 (N = 184)	Age 21 and above (N = 103)	Under age 21 (N = 164)	Age 21 and above (N = 105)
<b>Mint/menthol</b> <sup>a</sup>	282 (48.2)	138 (48.1)	226 (51.6)	127 (56.4)	77 (18.0)	40 (17.2)	55 (29.9)	30 (29.1)	53 (32.3)	28 (26.7)
Mint	202 (34.5)	95 (33.1)	167 (38.1)	87 (38.7)	44 (10.3)	22 (9.5)	40 (21.7)	24 (23.3)	37 (22.5)	21 (20.0)
Wintergreen	60 (10.3)	35 (12.2)	60 (13.7)	31 (13.8)	5 (1.2)	5 (2.2)	4 (2.2)	1 (0.9)	2 (1.2)	0 (0.0)
Menthol <sup>b</sup>	120 (20.5)	63 (21.9)	<b>93 (21.2)</b>	<b>68 (30.2)</b>	28 (6.6)	13 (5.6)	11 (6.0)	5 (4.8)	14 (8.5)	7 (6.7)
<b>Fruit</b>	219 (37.4)	102 (35.5)	226 (51.6)	105 (46.2)	97 (22.7)	57 (24.6)	86 (46.7)	52 (50.5)	72 (43.9)	47 (44.7)
<b>Sweet/dessert/candy</b> <sup>a</sup>	143 (24.4)	71 (24.7)	130 (29.7)	76 (33.8)	59 (13.8)	17 (7.3)	24 (13.0)	12 (11.6)	20 (12.1)	14 (13.3)
Sweet/dessert	95 (16.2)	48 (16.7)	98 (22.4)	54 (24.0)	36 (8.4)	6 (2.6)	14 (7.6)	10 (9.7)	8 (4.9)	11 (10.5)
Candy	85 (14.5)	49 (17.1)	77 (17.6)	53 (23.5)	23 (5.4)	11 (4.7)	10 (5.4)	2 (1.9)	12 (7.3)	3 (2.9)
Tobacco flavored	<b>65 (11.1)</b>	<b>49 (17.1)</b>	<b>69 (15.7)</b>	<b>56 (24.9)</b>	20 (4.7)	11 (4.7)	2 (1.1)	2 (1.9)	2 (1.2)	1 (0.9)
Coffee or tea	54 (9.2)	30 (10.4)	44 (10.1)	27 (12.0)	8 (1.9)	6 (2.6)	2 (1.1)	3 (2.9)	2 (1.2)	4 (3.8)
Alcohol	<b>27 (4.6)</b>	<b>25 (8.7)</b>	56 (12.8)	26 (11.5)	5 (1.2)	2 (0.9)	0 (0.0)	0 (0.0)	3 (1.80)	0 (0.0)
Spice	29 (5.0)	15 (5.2)	<b>27 (6.2)</b>	<b>24 (10.7)</b>	3 (0.7)	0 (0.0)	2 (1.1)	0 (0.0)	1 (0.6)	0 (0)
Other Beverage (e. g., Coca-Cola)	<b>24 (4.1)</b>	<b>22 (7.7)</b>	27 (6.2)	17 (7.5)	3 (0.7)	3 (1.3)	1 (0.5)	0 (0.0)	2 (1.2)	1 (0.9)
Unflavored	13 (2.2)	10 (3.5)	22 (5.0)	13 (5.8)	12 (2.8)	2 (0.9)	4 (2.2)	1 (1.0)	3 (1.8)	3 (2.9)
Other	39 (6.7)	13 (4.5)	30 (6.8)	18 (8.0)	22 (5.1)	13 (5.6)	6 (3.3)	1 (0.9)	4 (2.4)	2 (1.9)
Don't know/ Don't remember	163 (27.9)	71 (24.7)	90 (20.5)	45 (20.0)	121 (28.3)	81 (34.9)	2 (1.1)	2 (1.9)	2 (1.2)	5 (4.7)

Note: All flavor types reported (not mutually exclusive categories of use);

<sup>a</sup>. 'Mint/menthol' flavor type shows any use of mint, menthol, wintergreen or ice flavors and 'sweet/dessert/candy' flavor type shows any use of sweet, dessert or candy flavors;

<sup>b</sup>. Menthol includes all ice flavors;

<sup>c</sup>. Flavors used most often. Bold indicates significant differences between flavor categories used by participants under 21 and 21 and above.

**Table 4**

Popularity of e-cigarette brands, overall and by legal age of tobacco purchase, no. (%).

	Heard about this brand			p-value
	Total sample (N = 4315)	Under age 21 (N = 2885)	Age 21 and above (N = 1430)	
Pod/cartridge-based e-cigarettes (N = 3,936)				
JUUL	3588 (91.2)	2393 (91.3)	1195 (90.9)	0.737
Suorin	884 (22.5)	578 (22.0)	306 (23.3)	0.378
MyBlu	632 (16.1)	411 (15.7)	221 (16.8)	0.357
Phix	583 (14.8)	384 (14.6)	199 (15.1)	0.678
Stiizy	587 (14.9)	388 (14.8)	199 (15.1)	0.773
Disposable e-cigarettes (N = 3,320)				
Puff Bar	2019 (60.8)	1358 (61.1)	661 (60.2)	0.611
VGOD Stig	1031 (31.1)	705 (31.7)	326 (29.7)	0.233
Mojo	934 (28.1)	640 (28.8)	294 (26.8)	0.222
Posh	836 (25.2)	575 (25.9)	261 (23.8)	0.188
Fogg	791 (23.8)	527 (23.7)	264 (24.0)	0.835
Halo	732 (22.0)	503 (22.6)	229 (20.9)	0.244
Unicorn	616 (18.6)	409 (18.4)	207 (18.8)	0.756
<b>Most popular brand among your peer group</b>				
Pod/cartridge-based e-cigarettes (N = 3,612)				
JUUL	3110 (86.1)	2078 (86.1)	1032 (86.0)	0.225
Suorin	207 (5.7)	131 (5.4)	76 (6.3)	
MyBlu	75 (2.1)	47 (1.9)	28 (2.3)	
Phix	116 (3.2)	77 (3.2)	39 (3.3)	
Stiizy	104 (2.9)	79 (3.3)	25 (2.1)	
Disposable e-cigarettes (N = 3,819)				
Puff Bar	1676 (43.9)	1128 (44.0)	548 (43.6)	0.951
VGOD Stig	414 (10.8)	284 (11.1)	130 (10.3)	
Mojo	488 (12.8)	332 (12.9)	156 (12.4)	
Posh	349 (9.1)	228 (8.9)	121 (9.6)	
Fogg	253 (6.6)	168 (6.6)	85 (6.8)	
Halo	384 (10.0)	253 (9.9)	131 (10.4)	
Unicorn	255 (6.7)	168 (6.6)	87 (6.9)	

Note: Due to missing data, percentages reported out of number of responses. P-values < 0.05 indicate significant differences between participant responses under 21 and 21 and above.