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Trends in Nicotine Strength in Electronic Cigarettes Sold in the United States by Flavor, Product Type, and Manufacturer, 2017–2022

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Abstract

Introduction: Most e-cigarettes contain highly addictive nicotine. This study assessed trends in nicotine strength in e-cigarettes sold in the United States during January 2017–March 2022.

Aims and Methods: We obtained January 2017–March 2022 national retail e-cigarette sales data from NielsenIQ. We assessed monthly average nicotine strength overall, by e-cigarette product and flavor type, and manufacturer. A Joinpoint regression model assessed the magnitude and significance of changes in nicotine strength.

Results: During January 2017–March 2022, monthly average nicotine strength of e-cigarette products increased from 2.5% to 4.4%, an average of 0.8% per month ($p < .001$). Monthly average nicotine strength of disposable e-cigarettes increased the most (average monthly percentage change [AMPC] = 1.26%, $p < .001$) as compared to prefilled pods (AMPC = 0.6%, $p < .001$) and e-liquids (AMPC = 0.5%, $p = .218$). Monthly average nicotine strength for all flavors of e-cigarette products increased except for mint-flavored products. Increases were greatest for beverage-flavored products (AMPC = 2.1%, $p < .001$), followed by menthol-flavored products (AMPC = 1.2%, $p < .001$). Among the top 10 e-cigarette manufacturers assessed, monthly average nicotine strength decreased for Juul Labs products from 5% to 4.7% (AMPC = −0.1%, $p < .001$) but increased significantly for five manufacturers' products and remained unchanged at 5%–6% for four manufacturers' products.

Conclusions: Monthly average nicotine strength of e-cigarette products increased overall, for most product and flavor types, and for some manufacturers in the United States during the

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Supplementary Material

A Contributorship Form detailing each author's specific involvement with this content, as well as any supplementary data, are available online at https://academic.oup.com/ntr.

Declaration of Interests

None declared.

study period. Imposing maximum limits on nicotine strength of e-cigarettes together with other evidence-based tobacco control strategies can help reduce the use of e-cigarettes among youth and increase tobacco product cessation among adults.

Implications: From January 2017 to March 2022, the monthly average nicotine strength of disposable e-cigarettes increased substantially and exceeded prefilled pods since May 2020. E-cigarettes with menthol flavor and youth-appealing flavors, like fruit, also had sharp increases in monthly average nicotine strength. Among the top 10 e-cigarette manufacturers, monthly average nicotine strength increased or remained unchanged at a high nicotine level for all manufacturers' products, except Juul Lab's products. Comprehensive strategies including restricting sales of all flavored e-cigarettes, restricting youth tobacco product access, and imposing maximum limits on nicotine strength may help reduce youth e-cigarette use and increase tobacco cessation.

Introduction

Although cigarette smoking has declined among U.S. adults and youth, the use of electronic cigarettes (e-cigarettes) has increased since their introduction to the U.S. market in 2007.[1] In 2020, current use of e-cigarettes was 3.3% among U.S. adults and 13% among youth[2,3]; since 2014, e-cigarettes are the most commonly used tobacco products among U.S. youths.[4] In 2016, the U.S. Surgeon General concluded that e-cigarette use among U.S. youth and young adults is a major public health concern and issued a *Call to Action*.[1]

Most e-cigarettes contain nicotine, which is a highly addictive drug.[1] Adolescent nicotine exposure harms the developing brain and may increase the risk for future addiction to other drugs.[1] Prior to 2015, when Juul Labs (Juul) entered the U.S. market, the average nicotine strength of e-cigarette products was 1% to 2.4%.[5] Subsequent to Juul's entry, other e-cigarette manufacturers entered the market, and existing competitors increased the nicotine strength of their products, resulting in an increase in nicotine strength across all e-cigarette products in the United States.[6] E-cigarette products come in a wide range of flavors.[1] The widespread availability and popularity of flavored e-cigarettes among youth can facilitate initiation and nicotine addiction and stimulate smoking behavior among this group.[7,8] High nicotine strength in flavored e-cigarette products may pose an increased risk for youth initiation and subsequent nicotine addiction.

To date, a few studies have analyzed the annual sales of e-cigarette products by nicotine strength,[6,9,10] and one study has examined the trends of nicotine strength in e-cigarettes sold in the United States.[6] This study found that the annual average nicotine concentrations in e-cigarettes sold increased from 2.10% to 4.34% during 2013–2018, and increased for all flavor categories, and for rechargeable e-cigarettes.[6] Little is known about recent trends in nicotine strength of e-cigarette products, particularly monthly trends by product type, flavor type, and manufacturer. Such updates are important to account for dynamic changes in the e-cigarette market. Using NielsenIQ data, this study fills this evidence gap by analyzing the monthly trends of nicotine strength overall and by product type, flavor type, and manufacturer in the United States from January 2017 to March 2022. The information generated from this study can help monitor changes in characteristics of e-cigarettes sold in the U.S. market and provide information for public health policy and practice on nicotine

strength and flavors in e-cigarettes sold which might affect the appeal and frequency of e-cigarette use among youth.

Methods

Data Source

We obtained nationally representative retail e-cigarette sales data from NielsenIQ. NielsenIQ data included 4-week aggregates (monthly) product characteristics, including manufacturer and brand for each Universal Product Code (UPC) and data on unit sales for each UPC. NielsenIQ uses a proprietary sample-based method to estimate representative e-cigarette sales data for retail outlets using in-store barcode scanning equipment and in-person audits. NielsenIQ data represent e-cigarettes sales in convenience stores (chain, franchise, and independent, with and without provisions for gasoline) and sales in NielsenIQ's "All Outlet Combined" channel, which represents sales in food or grocery stores, pharmacies, mass merchandisers, club stores, discount or dollar stores, and military commissaries. NielsenIQ data do not include online sales and sales from tobacco specialty stores and vape shops.

Measures

Product Type.—We categorized e-cigarette products into three types based on UPC-specific information on the product description, product form, product claim, target use, and brand information: Disposable e-cigarettes, prefilled pods or cartridges including products containing rechargeable devices with prefilled pods or cartridges (prefilled pods), or e-liquid bottles for refill (e-liquids). Disposable e-cigarettes included single-use products that cannot be recharged or refilled. Prefilled pods included pods, cartridges, cartomizers, and capsules inserted into an e-cigarette device and items like starter kits that contained a rechargeable device. E-liquids were those products available in liquid forms such as vape liquid, vape juice, or e-cigarette liquid. Rechargeable devices only and accessories (replacement parts and empty fillable pods) were excluded from this analysis because they do not contain nicotine. In cases where the UPC-specific information provided by Nielsen was insufficient (4.13%), we identified and categorized products manually via extensive online search (ie, using brand and vendor websites). A small fraction of products could not be categorized because of insufficient information found in the data and online; those uncategorized products accounted for less than 0.002 percent of total e-cigarette unit sales during the study timeframe. We standardized e-cigarette units so that one unit of e-cigarette products equals one disposable e-cigarette, one e-liquid bottle, or five prefilled pods or cartridges.

Flavor.—There were about 580 flavors in the dataset provided by NieslenIQ. We classified e-cigarette products into six flavor types based on product and flavor description in the dataset: Beverage (eg, lemonade, soda), candy or sweet (eg, candy, vanilla), fruit (eg, banana, strawberry), menthol (eg, classic menthol, cool), mint (eg, classic mint, cool mint), or tobacco (eg, classic tobacco, original tobacco). These six categories accounted for 99.70% of all e-cigarette unit sales in the NielsenIQ data, with the remainder classified as either "Other" (0.24%) or "Not Stated" (0.06%). "Other" included products with ambiguous flavor descriptions that cannot be readily classified or identified, such as "Energy" or multiflavor combo packs, such as "Mint; Virginia Tobacco." "Not Stated" include products with no

flavor information provided. Products categorized as “Other” or “Not Stated” were excluded from the analysis (0.30%).

Manufacturer.—We identified the top 10 e-cigarette manufacturers (Juul, British American Tobacco, Imperial Tobacco, Njoy, Jak, Japan Tobacco, DS Technology Licensing, Bidi Vapor, Mngo, and Pop), based on 2020 e-cigarette unit sales (Supplementary Material, Appendix Table 1).

Nicotine Strength.—Nicotine strength was reported by NielsenIQ for about 73.7% of the total unique e-cigarette products during the study period. After excluding rechargeable devices and accessories, products with missing device and flavor information, products with zero-unit sales or missing unit sales over the study period, we had 136 unique products with no nicotine strength information, which accounted for 7.7% of the unique products in the sample (and 7.8% of unit sales). After excluding the products with missing nicotine strength, we had 1660 unique liquid-containing e-cigarette products in the analysis. Nicotine strength was reported either in percentage or milligrams of nicotine per milliliter of liquid (mg or ml). To standardize nicotine strength in percentage terms we divided mg or ml nicotine strength by 10.[6]

Analysis

We evaluated monthly average nicotine strength for e-cigarette products overall, by product type, flavor type, and manufacturer. To calculate the monthly average nicotine strength for each of the flavor, product type, and manufacturer categories for a given 4-week period, nicotine strength was weighted using units sold as a weighting factor, that is, the nicotine strength for each product was multiplied by the number of units sold then summed across all products in the category and then divided by the number of units sold in that category during that 4-week period.

We used Joinpoint regression[11] to detect segments of significant changes in the trends of monthly average nicotine strength and to quantify the relative amount of change. All joinpoint regressions accounted for autocorrelated errors, and trends were tested at a 5% significance level (2-sided). We estimated monthly percentage change for each identified segment as well as average monthly percentage change for the entire period, along with their 95% confidence intervals and *p*-values.

Results

Nicotine Strength, Overall, and by Product Type

During January 2017–March 2022, the monthly average nicotine strength of e-cigarette products increased from 2.5% to 4.4%, an average of 0.8% per month ($p < .001$) (Figure 1, Supplementary Material, Appendix Table 2). By product type, the monthly average nicotine strength of prefilled pods increased from 2.9% to 4.4%, an average of 0.6% per month ($p < .001$), and disposable e-cigarettes increased from 2.1% to 4.8%, an average of 1.3% per month ($p < .001$). In addition, monthly average nicotine strength of disposable e-cigarettes increased from 3.4% in November 2019 to 4.3% in February 2020, an average of 8.6% per

month ($p < .001$). Monthly average nicotine strength of e-liquids did not show significant changes (AMPC = 0.5%, $p = .218$), although there were some fluctuations over time.

Nicotine Strength by Flavor Type

Monthly average nicotine strength for almost all flavored e-cigarette products increased except for mint-flavored products (Figure 2, Supplementary Material, Appendix Table 3). During January 2017–March 2022, monthly average nicotine strength increased for beverage-flavored e-cigarettes from 1.2% to 5.3% (AMPC = 2.1%, $p < .001$), for menthol-flavored e-cigarettes from 2.0% to 4.5% (AMPC = 1.2%, $p < .001$), for tobacco-flavored e-cigarettes from 2.3% to 4.1% (AMPC = 0.9%, $p < .001$), for fruit-flavored e-cigarettes from 2.6% to 5.1% (AMPC = 0.8%, $p < .001$), and for candy or sweet-flavored products from 3.0% to 3.9% (AMPC = 0.5%, $p = .027$). Monthly average nicotine strength for mint-flavored products did not show significant changes (AMPC = −0.1, $p = .230$).

Nicotine Strength by Top Manufacturer

During January 2017–March 2022, monthly average nicotine strength decreased for Juul products from 5% to 4.7% (AMPC = −0.1%, $p < .001$), but increased for Imperial Tobacco products from 2.2% to 2.4% (AMPC = 0.2%, $p < .001$), for Njoy products from 3.3% to 5% (AMPC = 0.6%, $p < .001$), for Jak products from 1.6% to 3.5% (AMPC = 1.1%, $p < .001$), and for Japan Tobacco products from 2.1% to 2.5% (AMPC = 0.2%, $p < .001$) (Figure 3), Supplementary Material, Appendix Table 4). Monthly average nicotine strength for British American Tobacco products also increased, from 3% since its entry into the market in November 2017 to 4.1% in March 2022 (AMPC = 0.6%, $p = .020$). Monthly average nicotine strength for Pop products did not change significantly since its entry into the market in July 2019 (AMPC = 0.3%, $p = .146$). Monthly average nicotine strength for DS Tech Licensing products also did not change significantly since its inception in the market in March 2019 (AMPC = −0.0%, $p = .226$). Monthly average nicotine strength for Mngo and Bidi Vapor products remained unchanged at 6% since they entered the e-cigarette market in December 2018 and August 2019, respectively.

Discussion

We found that the monthly average nicotine strength of e-cigarette products increased from 2.5% in January 2017 to 4.4% in March 2022; these increases were primarily for disposable e-cigarettes and particular flavors such as menthol, fruit, and candy or sweet many of which are particularly attractive to youth and young adults.[7] We also found differences in nicotine strength by manufacturer. By product type, monthly average nicotine strength of prefilled pods and disposable e-cigarettes increased during the study period, but monthly average nicotine strength of e-liquids did not change significantly. Monthly average nicotine strength of disposable e-cigarettes more than doubled during the study period and rose sharply from November 2019 to February 2020, which might be because of the introduction of new high-nicotine concentration disposable e-cigarette products into the market in late 2018 and 2019 (such as Puff Bars; manufacturer: DS Tech Licensing), Mngo Stick (manufacturer: Mngo), and Pop Disposable Vape Pen (manufacturer: Pop). These disposable devices entered the market with a high nicotine strength of 5% to 6% and have grown in popularity since.

They also come in various flavors attractive to youth such as beverage, candy or sweet, and fruit.[7] We also found that the monthly average nicotine strength increased for all flavored e-cigarette products except for mint-flavored products. Among the four flavor categories (menthol, tobacco, mint, and fruit) that made up 96.5% of e-cigarette unit sales across the study period, monthly average nicotine strength of menthol-flavored products increased the most, by an average of 1.2% per month. In addition, monthly average nicotine strength for flavors appealing to youth such as beverage and fruit, all increased significantly during the study period.

In January 2020, the U.S. Food and Drug Administration made an announcement to prioritize enforcement against cartridge-based non-tobacco and non-menthol flavored nicotine pods, but tank-based flavored nicotine e-liquids and disposables were not covered by the policy.[12] In 2022, among youth who currently used e-cigarettes, more than one in four (27.6) used them daily and more than four in ten (42.3%) used them on 20 or more of the past 30 days; almost 85% used flavored e-cigarettes, and disposable e-cigarettes were the most commonly reported e-cigarette product type.[7] Given that flavors can mask the harshness of tobacco products and play a significant role in drawing youth and young adults to initiate smoking,[13] these disposable products with high nicotine strength could increase tobacco use addiction and make quitting more difficult. High nicotine strength in flavored e-cigarette products predominately used by certain populations, such as youth,[7] may sustain tobacco-related health disparities and increase inequities.

Among the top 10 e-cigarette manufacturers, monthly average nicotine strength increased for products manufactured by Imperial Tobacco, Njoy, Jak, and Japan Tobacco and remained unchanged at a high nicotine strength level of 5%–6% for Pop, DS Tech Licensing, Mngo, and Bidi Vapor products. Juul and British American Tobacco were the top two manufacturers and made up 65% of all unit sales in 2020. Both manufacturers made refillable pod products exclusively for the e-cigarette market, which explained the high market share of prefilled pod products among overall e-cigarettes sold. Although monthly average nicotine strength for Juul decreased over time by 0.1% per month, Juul products' monthly average nicotine strength remained high with beginning strength of 5% and ending strength of 4.7% during the study period. The decrease in Juul's nicotine strength beginning in late 2018, after remaining constant at 5% until then, was because Juul began selling 3% nicotine products in addition to their original 5% products as of September 2018. The 5% products still dominated Juul's production given the high average nicotine strength of Juul products over time.

Limitations

This study is subject to limitations. First, NielsenIQ data did not provide sales from the Internet, tobacco specialty shops, or vape shops. However, NielsenIQ data included the majority of U.S. e-cigarette market and can be representative of U.S. national sales.[14] Second, NielsenIQ did not collect purchaser demographics (eg, race, age); therefore, individual-level characteristics of purchasers are unknown. Third, nicotine strength in e-cigarette products does not necessarily reflect the actual amount of nicotine absorbed by e-cigarette users, which is dependent on many other factors.[15] Fourth, we excluded

products with missing information on nicotine strength, which could lead to some bias in the estimates. Fifth, historical events, public health issues, and regulatory actions and manufacturer marketing decisions could have affected the trends of nicotine strength in e-cigarettes sold in the U.S. market; effects of these interconnected changes are difficult to estimate.

Conclusions

From January 2017 to March 2022, monthly average nicotine strength of e-cigarette products increased substantially overall as well as for most product and flavor types and for some manufacturers in the United States. Although some U.S. states[16,17] regulated nicotine strength in e-cigarettes sold in the U.S. market, there are currently no such regulations at the federal level. However, several peer nations, including the United Kingdom and the entire European Union, already limit e-cigarette nicotine strength to 2% in an attempt to reduce e-cigarette appeal and addictiveness.[18,19] The Food and Drug Administration recently announced plans to limit nicotine levels in combustible cigarettes in the United States.[20] If such regulations are enacted without any parallel regulations to limit nicotine levels in e-cigarettes, there is a risk of increased nicotine addiction among new users of high-nicotine concentration e-cigarette products (including youth and other vulnerable populations).[21] Comprehensive strategies including restricting sales of all flavored e-cigarettes and imposing maximum limits on nicotine strength of e-cigarettes may help reduce the use of e-cigarettes among youth and increase tobacco cessation among adults and reduce health and economic burden of tobacco use.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Disclaimers

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the U.S. Centers for Disease Control and Prevention (CDC). CDC's analyses and calculations are based in part on data reported by NielsenIQ through its Scantrack Service for the 4-week period ending March 19, 2022, for the Total U.S. All Outlet Combined + Convenience markets. The conclusions drawn from the NielsenIQ data are those of the authors and do not reflect the views of NielsenIQ. NielsenIQ is not responsible for and had no role in and was not involved in analyzing and preparing the results reported herein. Use of NielsenIQ data does not imply an endorsement of any particular organization, service, or product.

Data Availability

The proprietary data underlying this article were provided by NielsenIQ under license or by permission. Data may be shared on request to the corresponding author with the permission of NielsenIQ.

References

1. U.S. Department of Health and Human Services. E-cigarette use among youth and young adults: A report of the Surgeon General. In: Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Controls and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2016: https://www.cdc.gov/tobacco/data_statistics/sgr/e-cigarettes/pdfs/2016_sgr_entire_report_508.pdf.
2. Cornelius ME, Loretan CG, Wang TW, Jamal A, Homa DM. Tobacco product use among adults - United States, 2020. MMWR Morb Mortal Wkly Rep. 2022;71(11):397–405. [PubMed: 35298455]
3. Gentzke AS, Wang TW, Jamal A, et al. Tobacco product use among middle and high school students - United States, 2020. MMWR Morb Mortal Wkly Rep. 2020;69(50):1881–1888. [PubMed: 33332300]
4. Gentzke AS, Creamer M, Cullen KA, et al. Vital Signs: Tobacco Product Use Among Middle and High School Students - United States, 2011-2018. MMWR Morb Mortal Wkly Rep. 2019;68(6):157–164. [PubMed: 30763302]
5. How much nicotine is in JUUL? https://truthinitiative.org/research-resources/emerging-tobacco-products/how-much-nicotine-juul#:~:text=Before%20JUUL%20was%20introduced%20in,5%20percent%20of%20nicotine%20strength. Accessed August 30, 2022.
6. Romberg AR, Miller Lo EJ, Cuccia AF, et al. Patterns of nicotine concentrations in electronic cigarettes sold in the United States, 2013–2018. Drug Alcohol Depend. 2019;203(October 1):1–7. [PubMed: 31386973]
7. Cullen MCEP-LCRMCAJKA. E-cigarette use among middle and high school students — United States, 2022. MMWR Morb Mortal Wkly Rep. 2022;69(37):1310.
8. Kong G, Morean ME, Cavallo DA, Camenga DR, Krishnan-Sarin S. Reasons for electronic cigarette experimentation and discontinuation among adolescents and young adults. Nicotine Tob Res. 2015;17(7):847–854. [PubMed: 25481917]
9. Ali FRM, Seaman EL, Crane E, Schillo B, King BA. Trends in US e-cigarette sales and prices by nicotine strength, overall and by product and flavor type, 2017-2022. Nicotine Tob Res. 2022 Dec 29.
10. Day HR, Ambrose BK, Schroeder MJ, Corey CG. Point of sale scanner data for rapid surveillance of the e-cigarette market. Tob Regul Sci. 2017;3(3):325–332. [PubMed: 28966951]
11. National Cancer Institute. Joinpoint trend analysis software. 2021; https://surveillance.cancer.gov/joinpoint/. Accessed December 2, 2021.
12. FDA finalizes enforcement policy on unauthorized flavored cartridge-based e-cigarettes that appeal to children, including fruit and mint. https://www.fda.gov/news-events/press-announcements/fda-finalizes-enforcement-policy-unauthorized-flavored-cartridge-based-e-cigarettes-appeal-children. Accessed August 12, 2022.
13. Feirman SP, Lock D, Cohen JE, Holtgrave DR, Li T. Flavored tobacco products in the united states: a systematic review assessing use and attitudes. Nicotine Tob Res. 2016;18(5):739–749. [PubMed: 26315475]
14. Seaman EL, Ali FRM, Schillo BA, Vallone DM, King BA. Different times call for different measures: using retail sales to monitor the tobacco product landscape. Am J Prev Med. 2022;63(3):e99–e102. [PubMed: 35599174]
15. Goniewicz ML, Smith DM, Edwards KC, et al. Comparison of nicotine and toxicant exposure in users of electronic cigarettes and combustible cigarettes. JAMA Netw Open. 2018;1(8):e185937. [PubMed: 30646298]
16. Information about state, local, and federal tobacco and nicotine laws. https://www.mass.gov/service-details/information-about-state-local-and-federal-tobacco-and-nicotine-laws#:~:text=State%20law%20requires%20tobacco%20manufacturers%20to%20submit%20annual,by-laws%20to%20further%20regulate%20tobacco%20and%20nicotine%20products. Accessed October 7, 2022.
17. E-CIGARETTE REGULATIONS - UTAH. https://www.publichealthlawcenter.org/resources/us-e-cigarette-regulations-50-state-review/ut. Accessed October 7, 2022.

18. E-cigarettes: regulations for consumer products. https://www.gov.uk/guidance/e-cigarettes-regulations-for-consumer-products#:~:text=The%20requirements%3A,no%20more%20than%2020mg%2Fml. Accessed August 12, 2022.

19. DIRECTIVE 2014/40/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 3 April 2014 on the approximation of the laws, regulations and administrative provisions of the Member States concerning the manufacture, presentation and sale of tobacco and related products and repealing. https://health.ec.europa.eu/system/files/2016-11/dir_201440_en_0.pdf. Accessed August 12, 2022.

20. FDA Announces Plans for Proposed Rule to Reduce Addictiveness of Cigarettes and Other Combusted Tobacco Products. https://www.fda.gov/news-events/press-announcements/fda-announces-plans-proposed-rule-reduce-addictiveness-cigarettes-and-other-combusted-tobacco. Accessed August 30, 2022.

21. Do EK, O'Connor K, Perks SN, et al. E-cigarette device and liquid characteristics and E-cigarette dependence: a pilot study of pod-based and disposable E-cigarette users. Addict Behav. 2022;124(January 1):107117. [PubMed: 34555560]

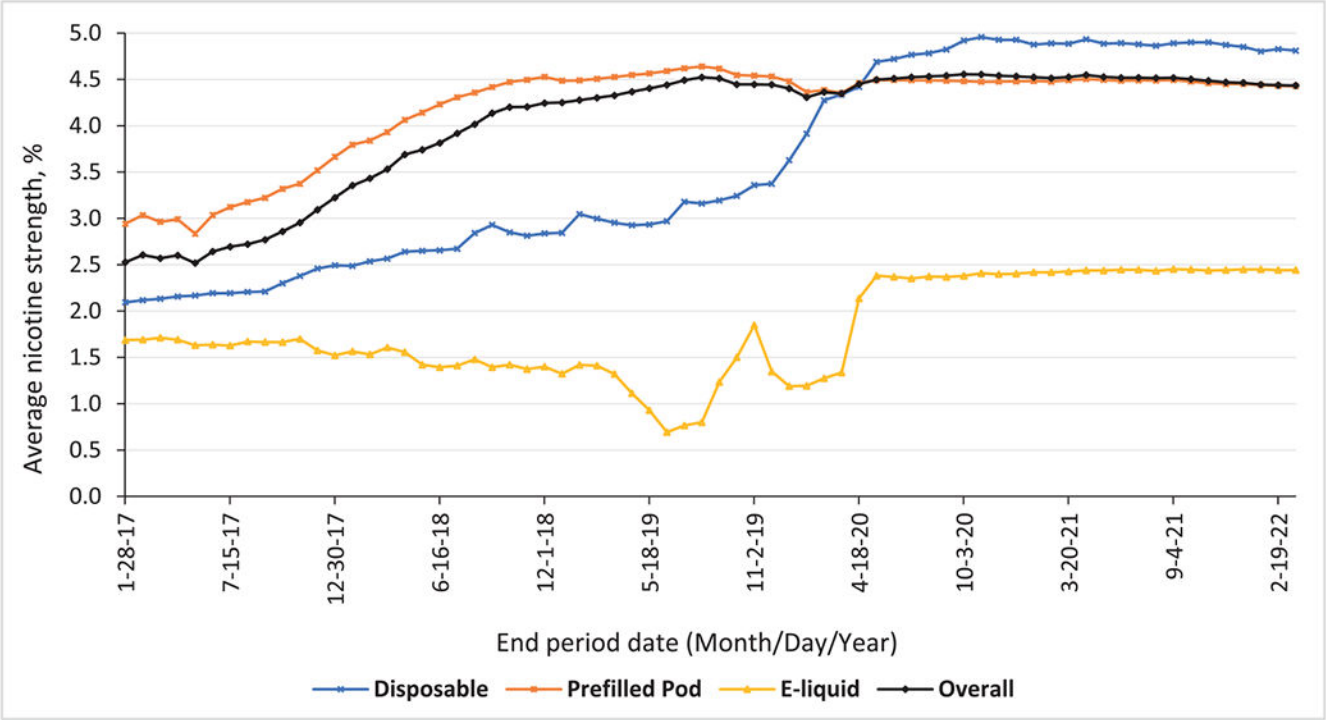

Figure 1.
Monthly average nicotine strength of e-cigarettes overall and by product type, January 2017–March 2022.

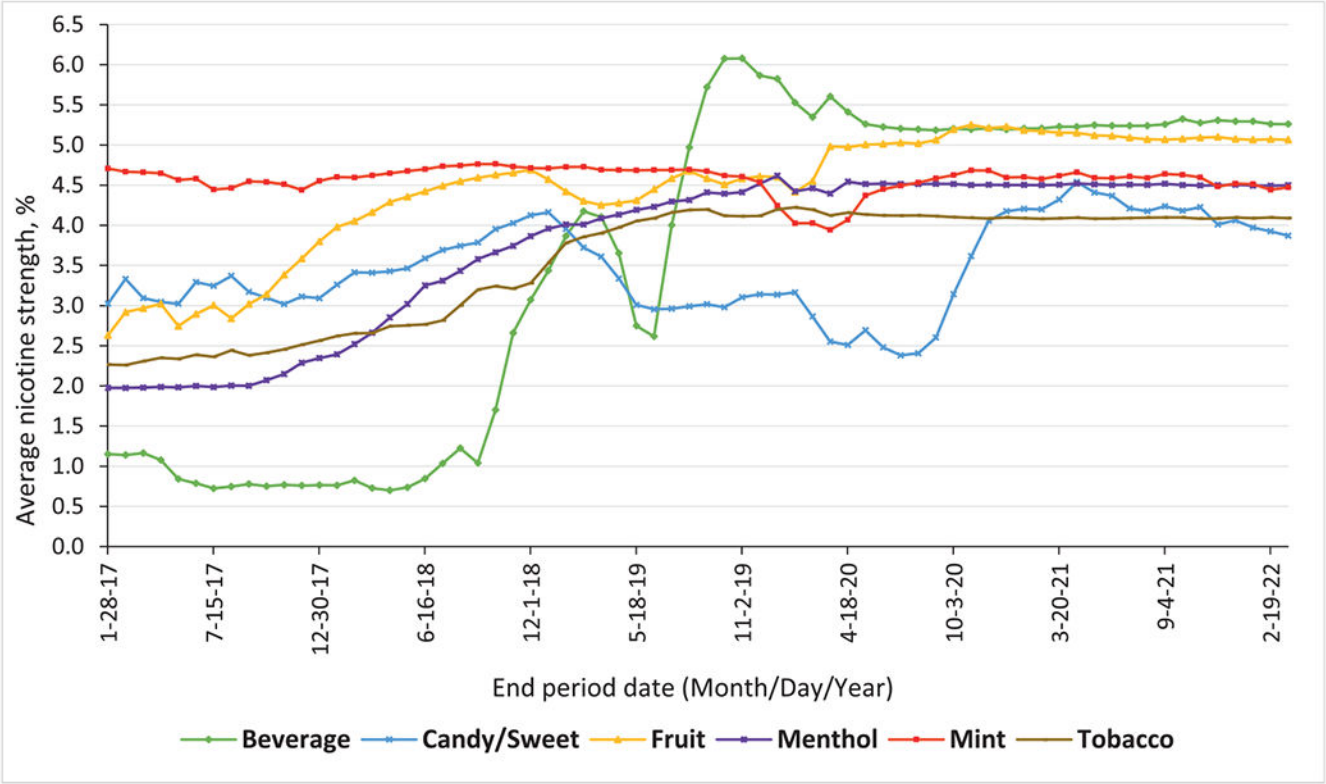

Figure 2.
Monthly average nicotine strength of e-cigarettes by flavor type, January 2017–March 2022.

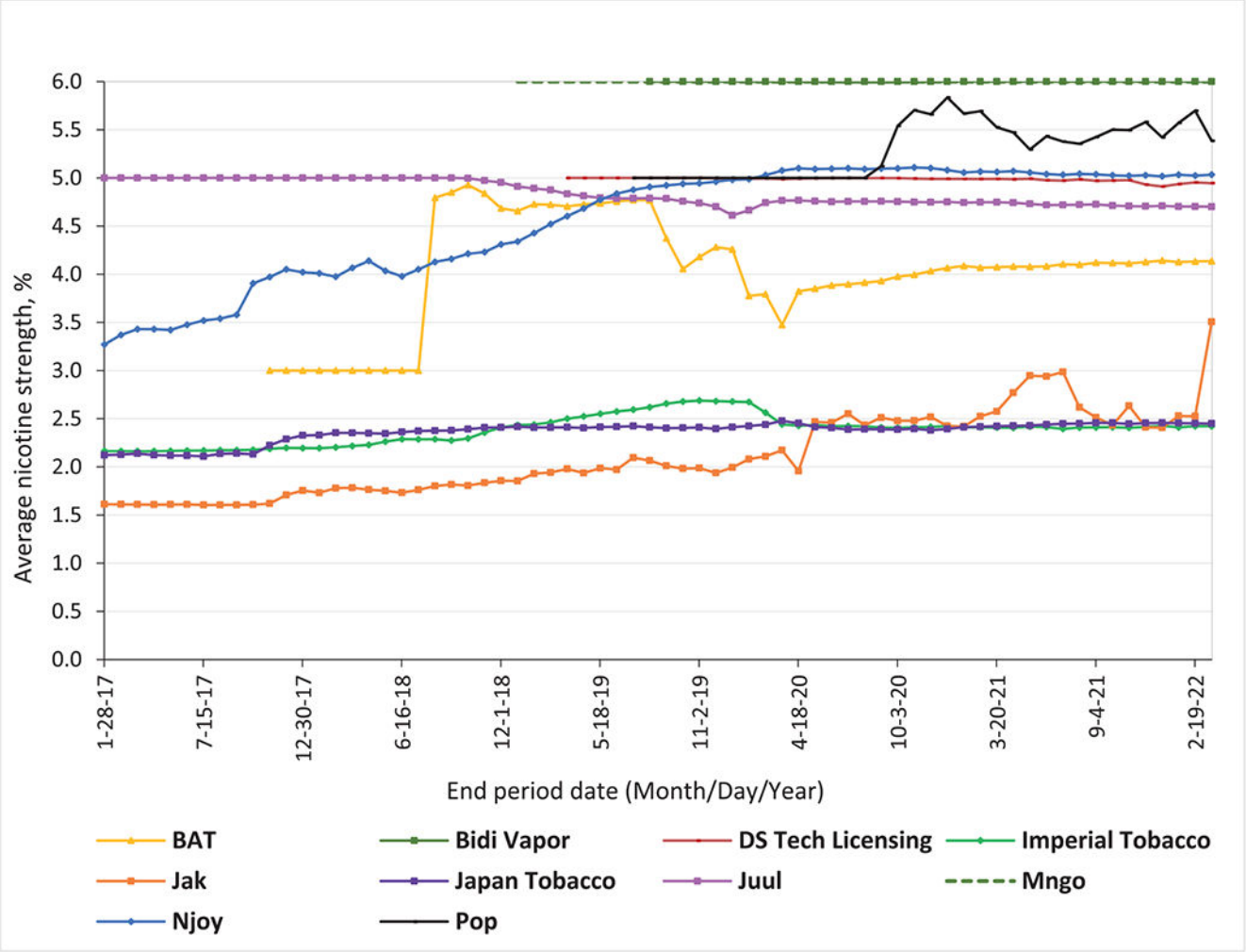

Figure 3.

Monthly average nicotine strength of e-cigarettes by top manufacturer, January 2017–March 2022.The trend of average nicotine strength for Mngo products overlapped with that for Bidi Vapor products during August 2019–March 2022 because average nicotine strength for Mngo products remained 6% during December 2018–March 2022 and average nicotine strength for Bidi Vapor products remained 6% during August 2019–March 2022.The trend of average nicotine strength for DS Technology Licensing products overlapped with that for Pop products during July 2019–August 2020 because average nicotine strength for DS Technology Licensing products remained around 5% during March 2019–August 2020 and average nicotine strength for Pop products remained 5% during July 2019–August 2020.