



## Flavored electronic nicotine delivery systems ads (2019–2020) on traditional U.S. Media by audience demographics

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### ABSTRACT

The tobacco industry has historically targeted flavored products to specific U.S. consumer segments, including young people, women, and systemically marginalized groups based on race, ethnicity, or sexual/gender identity. Existing research on target marketing is focused on cigarettes and smokeless tobacco. In contrast, studies of target marketing of electronic nicotine delivery systems (ENDS)—a growing segment of the U.S. tobacco product market – are much more limited. We analyzed data on 496 ENDS ads and audience demographics to explore the extent to which flavored ENDS ads on cable television (n = 25 ads), terrestrial radio (n = 412 ads), and in print consumer magazines (n = 59 ads) are targeted to different demographic groups based on age, sex, and race/ethnicity. We observed flavor-related content in one-quarter to one-third of ENDS ad occurrences during 2019–2020. Across all media outlets examined, audience age was an important factor in explaining the likelihood of ENDS ads containing flavor-related content. For example, within a television channel, there were 3.82 [95% confidence interval (CI): 1.39–10.49] times greater odds that an ENDS ad contained flavor-related content versus not for every 1% increase in the proportion of U.S. youth ages 6–17 watching a television show. In addition, there were 2.13 [95 %CI: 1.30–3.51] and 1.61 [95 %CI:1.60–1.63] times greater odds that an ENDS ad contained flavor-related content versus not in cable television and radio stations, respectively, for every 1% increase in the proportion of male audience members. Race/ethnicity was an important explanatory factor for the presence of flavor-related content on radio but not television ENDS ads. Our findings suggest differences in target marketing of flavored ENDS by media outlet and audience demographics.

### 1. Introduction

Commercial businesses use target marketing to promote products to different consumer segments based on demographics, geographic and economic variables, and values or attitudes (An et al., 2018; Beane and Ennis, 1987; Foedermayr and Diamantopoulos, 2008; Salminen et al., 2020). Consumer segmentation allows businesses to understand and match products to customer needs and direct advertising to those most receptive (Foedermayr and Diamantopoulos, 2008; Cooil et al., 2008). Consumers tend to purchase more of a product when they have been exposed to ads (Tuchman et al., 2018), and target marketing has the potential to increase ads' effectiveness at encouraging product

consumption (Grier and Kumanyika, 2010).

Target marketing is a public health concern when it is used to promote harmful or potentially harmful products, such as cigarettes, alcohol, fast food, lottery tickets, and credit cards (Grier and Kumanyika, 2010; Seiders and Petty, 2004), especially to those consumers perceived as particularly vulnerable to harms from product use (e.g., adolescents). The tobacco industry has an established history of targeting products to specific consumer segments in the U.S., including youth and young adults, women, and systemically marginalized groups based on race, ethnicity, or sexual identity (Ling and Glantz, 2002; Stevens et al., 2004; Toll and Ling, 2005; Cruz et al., 2019; Barbeau et al., 2005). Exposure to tobacco marketing is associated with

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increased tobacco consumption, including increased likelihood of initiation (Cruz et al., 2019; DiFranza et al., 2006; Kreitzberg et al., 2019; Qian et al., 2021; Nicksic et al., 2017). Studies suggest that exposure to tobacco ads among youth is substantial (Agaku et al., 2014; Marynak et al., 2018), and there is growing evidence of comparatively higher exposure to commercial tobacco ads among individuals who identify as racial, ethnic, and sexual minorities (e.g., bisexual Latinas) versus those who identify as heterosexual and White (Tan et al., 2021).

Most tobacco control research on target marketing has focused on cigarettes and smokeless tobacco (Ling and Glantz, 2002; Stevens et al., 2004; Toll and Ling, 2005; Cruz et al., 2019; Barbeau et al., 2005). Fewer studies investigate trends in target marketing of electronic nicotine delivery systems (ENDS), which are one of the fastest growing tobacco products in the U.S. market. ENDS are more likely to be used by youth and young adults (Gentzke et al., 2020; Cornelius et al., 2020), men (Cornelius et al., 2020), and individuals who identify as non-Latinx White (Cornelius et al., 2020). ENDS are available in wide range of flavors (e.g., mint, fruit, candy) (Ali et al., 2020), and most ENDS contain nicotine, which, in addition to being addictive, can harm adolescent brain development (US Department of Health and Human Services, 2016). Most ENDS users cite appealing product flavors as a main reason for ENDS use (Harrell et al., 2017; Huang et al., 2017; Zare et al., 2018), and flavor is frequently featured in ENDS ads (Laestadius et al., 2019; Nicksic et al., 2019; Rudy et al., 2020). Exposure to flavored ENDS ads has been associated with increased interest in trying ENDS (Vasiljevic et al., 2016). There is evidence that tobacco companies have targeted placement of ENDS ads in youth- and young adult-appealing television, radio, and magazine outlets (El-Toukhy and Choi, 2016; McCarthy, 2014). One other study found that ENDS ads that ran in U.S. magazines popular with women (e.g., Cosmopolitan, Essence) in 2014 were most frequently featured in magazines with a median readership age between 30 and 40 years old (Basch et al., 2016). However, there is limited up-to-date data that systematically examines the extent to which flavored ENDS ads (versus ads that do not promote flavored ENDS) may be targeted to different demographic groups across media outlets.

From 2015 to 2020, ENDS companies spent a substantial amount of ad expenditures on traditional media outlets like television (\$110 million), print (\$240 million), and radio (\$59 million), compared to other channels such as digital/online (\$23 million) (Ali et al., 2020; Welding et al., 2015–2020). Overall expenditures on ENDS ads increased from late 2018 through 2019, when spending on cable and online television ads notably increased (Duan et al., 2021; Federal Trade Commission, 2022) and radio ads (including online radio) more than doubled (Ali et al., 2020; Welding et al., 2015–2020; , 2022). These outlets may be valuable in terms of reaching different audience segments with targeted ENDS ads (Nicksic et al., 2019; El-Toukhy and Choi, 2016; Duan et al., 2021). The aim of the current study is to explore the extent to which flavored ENDS ads on television, radio, and in consumer magazines are targeted to different demographic groups based on age, sex, and race/ethnicity. Understanding who may be exposed to flavored ENDS ad content through traditional media outlets is an important surveillance strategy for understanding how the tobacco industry may use target marketing to promote flavored ENDS to different audience demographics.

## 2. Materials and methods

This study did not involve human subjects and was not subject to IRB approval.

### 2.1. Study sample

We purchased ads for this study from Numerator, a market research firm that monitors product advertising. We acquired all 496 unique English-language U.S. ENDS ads available in Numerator that ran during the study period (2019–2020) on the following traditional media

sources: cable television (n = 25 ads), terrestrial radio (n = 412 ads), and in print consumer magazines (n = 59 ads).

### 2.2. Flavored ENDS coding

We coded all ads for the presence of flavored ENDS content (yes/no). An ad was coded ‘yes’ for flavored ENDS content if (i) the ad directly promoted at least one tobacco or non-tobacco flavored ENDS product or (ii) the ad included a general mention of flavor in the ad as a key selling point (e.g., “satisfying flavors”). Ads in this sample that generally mentions flavor as a selling point did not include the presence of any flavored ENDS products. For any ads that promoted a flavored ENDS product, we coded for the flavor type (e.g., tobacco, menthol, fruit) of the product. We classified flavor type into three categories: tobacco flavored ENDS only, other flavored ENDS only, and tobacco-flavored plus other-flavored ENDS. The category of ‘other flavored ENDS’ included all non-tobacco flavors, like menthol, mint, fruit, candy, etc. A team of trained coders coded each ad for flavored ENDS content and all ads were double-coded. We trained all coders to an intercoder reliability standard of  $\geq 0.80$  and resolved any discrepancies in coding through consensus.

### 2.3. Unique ad occurrences on media outlets

Numerator provided metadata for the year (2019, 2020) and media outlet (cable television show and channel; terrestrial radio station; print consumer magazine) on which each ENDS ad in the sample ran. A single ENDS ad could appear more than once over the two-year study period. For example, a single radio ENDS ad could air on 12 different radio stations across the country in 2019 and then air again on the same 12 radio stations in 2020. We refer to each time the ad aired (for cable television and radio) or was published (for consumer magazines) on an outlet in a given year as a *unique ad occurrence*. In our example above, there would be 24 unique ad occurrences for the single radio ENDS ad.

In total, there were 25 cable television ENDS ads in our sample. These ads aired 23,392 unique times (i.e., 23,392 unique ad occurrences) on 745 cable television outlets. A cable television outlet was defined as each unique television show (e.g., Friends, n = 648 television shows aired ENDS ads) that ran on a network channel (e.g., TBS, Paramount Network, n = 40 network channels had shows that ran ENDS ads) during a given year (e.g., Friends\_TBS\_2019, Friends\_TBS\_2020, Friends Paramount Network\_2019).

In total, there were 412 radio ENDS ads in our sample. These ads aired 363,758 unique times (i.e., 363,758 unique occurrences) on 704 radio station outlets. A radio station outlet was defined as each unique terrestrial radio station (e.g., WERQ-FM, n = 477 radio stations ran ENDS ads) by year (e.g., WERQ-FM 2019, WERQ-FM 2020).

In total, there were 59 print consumer magazine ENDS ads in our sample. These ads ran 323 unique times (i.e., 323 unique ad occurrences) across 43 print magazine outlets. A print consumer magazine outlet was defined as each unique print consumer magazine (e.g., Maxim, n = 32 magazines ran ENDS ads) by year (e.g., Maxim\_2019; Maxim\_2020).

Each of the 496 ENDS ads in our sample had a unique identification number (ad ID) assigned by Numerator. Using the ad ID, we merged the metadata for each unique ad occurrence with the coded flavored ENDS data. Each row in the data set was a unique ad occurrence that had the following information: ad ID, the year the ad ran, cable television/radio station/print consumer magazine outlet name (e.g., Friends\_TBS\_2020; WERQ-FM\_2019; Maxim\_2019), and type of flavored ENDS content present in the ad.

### 2.4. Nielsen audience data

To characterize audience demographics of each unique cable television/radio station/print consumer magazine outlet, we purchased

proprietary Nielsen Media audience demographic data for each outlet by year (January 1, 2019 – December 31, 2020).

For cable television and radio station outlets, Nielsen provided average annual audience ratings for each year (2019; 2020) by sex (% female; % male), age (% ages 6–17; % ages 18–34; % ages 35–99), and race/ethnicity (% Black, % Latinx, % Other race/ethnicity).

For cable television outlet ratings, Nielsen derived the numerator for each rating by estimating the total number of viewers from its proprietary audience panel in a given demographic group (e.g., persons ages 6–17) across the calendar year. Nielsen based the denominator for the rating on the total U.S. population for each demographic group (e.g., total U.S. persons ages 6–17). For example, if a cable television outlet (e.g., Friends\_TBS\_2020) had a rating of 3% for audience ages 6–17 in 2020, this indicates that 3% of the U.S. population ages 6–17 watched Friends on TBS in 2020.

For radio station outlet ratings, Nielsen derived the numerator for each rating by estimating the total number of listeners from their proprietary audience panel in a given group (e.g., males) across the calendar year. Nielsen based the denominator for the rating on the Metro area population for each demographic group (e.g., males in the Baltimore Metro area). For example, if a radio station outlet (e.g., WERQ-FM\_2020) had a rating of 10% for male listeners in 2020, this indicates that 10% of males in the Metro Baltimore area listened to WERQ-FM in 2020.

For print consumer magazine outlets, Nielsen provided estimates of annual consumer magazine readership based on audience survey data for each year (2019; 2020) by sex (% female, % male) and age (% ages 18–34; % ages 35–99). Nielsen based the denominator on the total estimated number of magazine readers from their survey data. For example, if a print magazine outlet had a readership that was 50% male in 2020, this means that half of all Maxim readers in 2020 were male.

To create our final dataset, we merged the Nielsen audience data into our dataset by unique cable television/radio station/print magazine outlet name.

## 2.5. Analysis

The unit of analysis for this study was unique ad occurrence. We selected this unit to represent the reach or volume of flavored-related ENDS content that is aired or printed each year and to which an audience may be exposed.

We conducted all data analyses at the ad occurrence level using Stata, Version 17. First, we produced descriptive statistics to characterize the prevalence of flavored advertising content at the ad occurrence level ( $n = 387,473$  occurrences) by media outlets (cable television, radio station, print consumer magazine). We examined the proportion of unique ad occurrences that included a general mention of flavor as a selling point in the ad or promoted at least one flavored ENDS products, and among those ads that promoted flavored ENDS products the type of flavored ENDS (tobacco flavor only, other flavor only, tobacco flavor plus other flavor).

Next, we used a series of multi-level models to examine the relationship between the presence of any flavor-related content (yes/no), which was defined as an ENDS ad including either a general mention of flavor as a selling point or promoting flavored ENDS products, and audience demographic characteristics. In total, we conducted eight separate models for television ENDS ads ( $n = 23,392$  occurrences), eight separate models for radio ENDS ads ( $n = 363,758$  occurrences), and four separate models for consumer magazine ENDS ads ( $n = 323$  occurrences). The independent variable for all 20 models was presence of flavor-related content (“no” [ref] versus “yes”). Each model included a single demographic predictor (e.g., % tv show audience ages 6–17) and controlled for year. To account for correlation among ad occurrences placed on the same media platform, our multi-level models grouped observations by the following cluster group variables: television channel ( $n = 40$ , for television ENDS ads only), radio station ( $n = 412$ , for radio

ENDS ads only), and magazine ( $n = 32$ , for consumer magazine ENDS ads only). For each media type, we reported the intraclass correlation (ICC) for the null model (outcome only by cluster group variable) and the range of ICC values across audience demographic models. All tests of significance were two-sided  $p < 0.05$ .

## 3. Results

Fig. 1 displays the proportion of ad occurrences containing flavor-related content by media type. Overall, 71.5% of cable television, 77.2% of radio station, and 64.1% of print consumer magazine ENDS ad occurrences that ran during 2019–2020 did not contain flavor-related content. Approximately 6.3% of cable television, 22.3% of radio station, and 18.9% of print consumer magazine ENDS ad occurrences featured flavor as a general selling point (i.e., no specific flavored ENDS product present). In addition, 22.2% of cable television, 0.5% of radio station, and 17.0% of print consumer magazine ENDS ad occurrences featured one or more flavored ENDS products.

Fig. 2 shows the proportion of ENDS ad occurrences by flavor type among those ads featuring at least one flavored ENDS product. All cable television ENDS ads occurrences with flavored products present featured both tobacco-flavor and other flavor ENDS. Most (92.0%) radio ENDS ads occurrences with flavored ENDS products featured other flavor ENDS (i.e., non-tobacco flavors). Around 42% of print consumer magazine ENDS occurrences with flavored ENDS products featured other flavor ENDS only, followed by 34% which featured tobacco flavor ENDS only, and 24% which featured both tobacco and other flavor ENDS.

Table 1 presents results from the multilevel logistic regression models by media type. For cable television ads, clustering of the ad occurrences within television channels accounted for approximately 83.8%–84.0% of the variance in the outcomes. Within a television channel, there were significantly greater odds of an ENDS ad containing flavor-related content versus not for every 1% increase in the proportion of U.S. population viewing the television show that was male (aOR = 2.13, 95 %CI: 1.30–3.51), ages 6–17 (aOR = 3.82, 95 %CI: 1.39–10.49), and ages 35–99 (aOR = 1.23, 95 %CI: 1.00–1.51), respectively. The proportion of U.S. population watching the television show that was female, ages 18–34, Black, Latinx, or Other race/ethnicity was not associated with the outcome, presence of flavored-related content in the ENDS ad. For radio ads, clustering of ad occurrences within a radio station accounted for 75.5%–85.4% of the variance in the outcomes. Within a radio station, there were significantly greater odds of ENDS ads containing flavor-related content versus not for every 1% increase in the proportion of the Metro area population listening to the radio station by sex, age, and race/ethnicity (aOR range: 1.21–1.61). For print consumer magazine ads, clustering of ad occurrences by magazine accounted for 19.2%–24.7% of the variance in the outcomes. Within a magazine, there were 1.09 (95 %CI: 1.02–1.16) times greater odds of an ENDS ad occurrence containing flavor-related content versus not for every 1% increase in the proportion of all magazine readers that were ages 18–34. The proportion of magazine readership by sex was not significantly associated with the outcome.

## 4. Conclusions

This study adds to what is known about ENDS advertising by providing up-to-date data on how ads for flavored ENDS products are targeted to different consumer groups. In this study, we observed that approximately one out of four cable television and radio ENDS ad occurrences and one out of three print consumer magazine ad occurrences that ran in the U.S. during 2019–2020 contained flavor-related content. Because flavor is an important feature that motivates ENDS use among current and novice users (Harrell et al., 2017; Huang et al., 2017; Zare et al., 2018), it is possible that exposure to flavored ENDS ads on traditional media is one pathway through which flavors may attract and

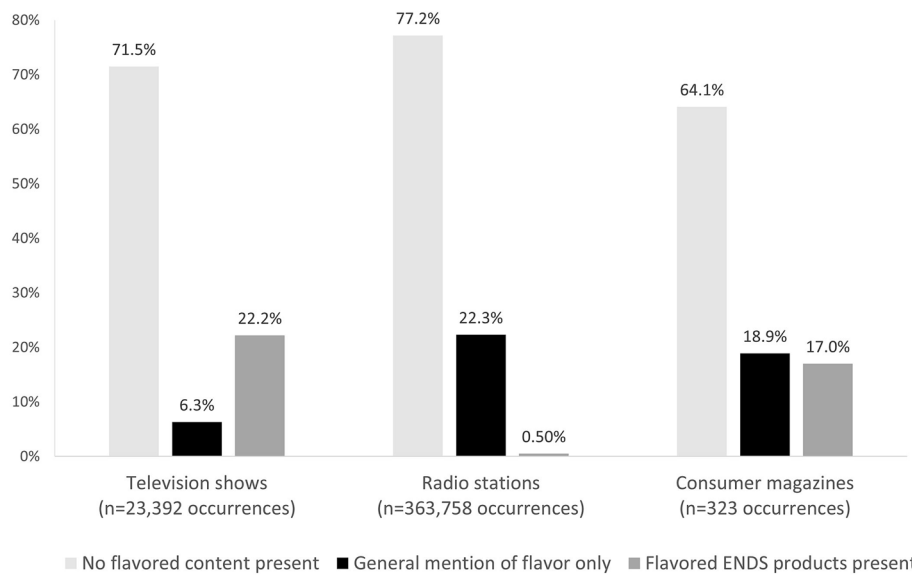


Fig. 1. Proportion of ENDS ad occurrences that included flavor-related content, by advertising media type, among U.S. ENDS ads that ran during 2019–2020.

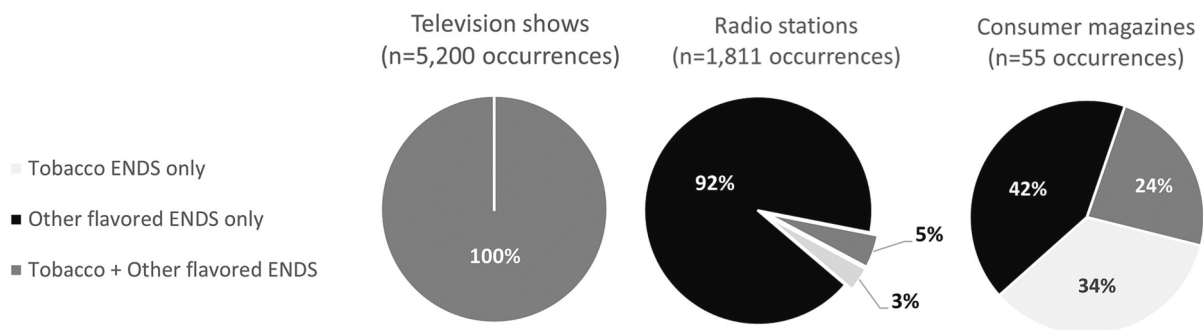


Fig. 2. Proportion of flavored ENDS products by flavor type among U.S. ENDS ad occurrences with flavored ENDS products present that ran during 2019–2020.

sustain product use. This is particularly relevant when taking into account the evidence that youth and adults are exposed to ENDS ads on television, radio, and print media outlets (Marynak et al., 2018; Wagoner et al., 2019), and exposure to ENDS ads in these outlets is associated with ever and current ENDS product use (Nicksic et al., 2017; Mantey et al., 2016; Singh et al., 2016; Ali et al., 2021).

This study is one of the first to systematically explore the extent to which flavored ENDS ads placed in traditional U.S. media outlets may be targeted to different demographic groups. Overall, we observed some differences in flavored ENDS marketing by media outlet, which may have implications for future research. First, we found that the presence of flavor-related content in radio ENDS ads with a given radio station was significantly associated with an increase in audience listenership across all sex, age, and race/ethnicity groups. Most radio ENDS ads with flavor-related content also only promoted the availability of flavors generally as a key selling point instead of advertising for specific flavored ENDS products. Together, these results suggest that radio is an important advertising platform for tobacco companies (Ali et al., 2020), and that terrestrial radio stations may be used to reach multiple, diverse audience segments with broad flavor-related information about ENDS.

Second, we found that flavor-related content in print consumer magazine ENDS ads was significantly more likely to be present when the proportion of young adult (ages 18–34) readers of a given magazine increased. This finding is consistent with prior research finding that ENDS ads were more likely to appear in magazines with a greater proportion of younger adult readership (El-Toukhy and Choi, 2016; Basch et al., 2016). In this study, most consumer magazine ENDS ad

occurrences with flavor-related content promoted a specific flavored product. This is particularly concerning given exposure to tobacco ads in magazines popular among youth and young adults (e.g., “People”) is associated with increased uptake of tobacco products (Loukas et al., 2021). Given the tobacco industry’s historic and continued investment in print and magazine ads (Ali et al., 2020), trends in flavored ENDS advertising and the influence of flavored ENDS ad exposure on behavioral outcomes among young people are important topics to regularly monitor.

Finally, we did not observe patterns of target marketing of flavored ENDS by the race/ethnicity of cable television show viewers. However, the odds of flavor-related content being present increased as the proportion of male viewership of a television show on a given channel increased. Because rates of ENDS use are higher among adolescent and adult males (Gentzke et al., 2020; Cornelius et al., 2020), it is possible that tobacco companies may strategically place flavor-related ad content in shows popular among males to recruit and sustain male ENDS users. In addition, we found that within a given television channel there were 3.8 times greater odds that an ENDS television ad occurrence contained flavor-related content versus not for every 1% increase in the proportion of youth viewers ages 6–17. However, it is important to note that we also found that there were significantly greater odds that an ENDS ad contained flavor-related content versus not on a given television channel for every 1% increase in the proportion of viewers ages 35–99. This could reflect intentional targeting of flavored television ENDS ads to older adults (e.g., for smoking cessation purposes) (Duan et al., 2021). In addition, our findings may highlight another potential point of exposure



**Table 1**

Adjusted multilevel logistic regression analyses predicting presence of flavor-related content in occurrences of U.S. ENDS ads that ran during 2019–2020 across media type (cable television, radio, print consumer magazines), by audience demographic characteristics.

Demographic group <sup>a</sup>	Flavor-related content present in ENDS ad		
	Cable television (n = 23,392 ad occurrences)	Radio (n = 363,758 ad occurrences)	Print consumer magazines (n = 323 ad occurrences)
	aOR <sup>b,c</sup> [95% CI]	aOR <sup>b,d</sup> [95% CI]	aOR <sup>b,e</sup> [95% CI]
<b>Sex</b>			
Female	1.14 [0.93–1.39]	<b>1.52 [1.51–1.54]</b>	1.00 [0.99–1.02]
Male	<b>2.13 [1.30–3.51]</b>	<b>1.61 [1.60–1.63]</b>	1.00 [0.98–1.01]
<b>Age</b>			
6–17	<b>3.82 [1.39–10.49]</b>	<b>1.42 [1.41–1.43]</b>	n/a
18–34	1.02 [0.65–1.62]	<b>1.59 [1.57–1.60]</b>	<b>1.09 [1.02–1.16]</b>
35–99	<b>1.23 [1.00–1.51]</b>	<b>1.56 [1.54–1.57]</b>	<b>0.92 [0.86–0.98]</b>
<b>Race/Ethnicity</b>			
Black <sup>f</sup>	1.06 [0.90–1.25]	<b>1.21 [1.20–1.22]</b>	n/a
Latinx <sup>f</sup>	0.85 [0.59–1.24]	<b>1.33 [1.32–1.34]</b>	n/a
Other <sup>g</sup>	0.89 [0.65–1.23]	<b>1.52 [1.51–1.54]</b>	n/a
ICC (null model only) <sup>h</sup>	0.834	0.599	0.277
ICC range (all models)	0.838–0.840	0.755–0.854	0.192–0.247

Note: aOR = adjusted odds ratio; 95 %CI = 95% confidence intervals; n/a = data not available; ICC = intraclass correlation.

Bolding indicates significance at  $p < 0.05$ .

<sup>a</sup> Independent variables are continuous proportions where each unit change is a 1% increase in the demographic group. For cable television outlets, proportions are based on number of viewers of X demographic group/U.S. population of X demographic group. For radio stations, proportions are based on number of listeners of X demographic group/Metro area population of X demographic group. For consumer magazines, proportion are based on number of readers of X demographic group/all readers of the magazine.

<sup>b</sup> Each model is adjusted for year of ad occurrence.

<sup>c</sup> Models group observations to account for clustering at the television channel level (e.g., VH1,  $n = 40$ ).

<sup>d</sup> Models group observations to account for clustering at the radio station level ( $n = 477$ ).

<sup>e</sup> Models group observations to account for clustering at the magazine level (e.g., “People”,  $n = 32$ ).

<sup>f</sup> Categories are not mutually exclusive.

<sup>g</sup> Includes any viewer who reported race/ethnicity but did not identify their race or ethnicity as Black or Latinx.

<sup>h</sup> Model only included the outcome and cluster group variable.

to flavored ENDS ad content among youth, where children may be exposed to flavored ENDS ads if they jointly view programs that their older adult household members watch (Domoff et al., 2019).

This study is subject to several limitations. First, our sample is only limited to the U.S. and to the television, radio, and print consumer magazine ENDS ads that Numerator tracked during 2019–2020 and may not be fully representative of all ENDS ads that ran on the media outlets in the U.S and abroad. Second, we did not examine target marketing of flavored ENDS in digital, and social media, which includes ads running on online television streaming platforms, online radio, online consumer magazines, other online web marketing, and commercial social media ads. Therefore, we are limited in assessing flavor-related content exposure in sources with higher levels of youth exposure, like digital and social media (Wagoner et al., 2019). In addition, we were limited to the audience demographic data provided by Nielsen Media and could not explore potential flavor ENDS ads exposure by other relevant demographic characteristics (e.g., socioeconomic status, sexual identity, etc.). We also only examined two years of data and cannot assess broader

trends in target marketing of flavored ENDS ad content over time and across media outlets.

Nonetheless, this study offers unique insight into the potential target marketing of flavored ENDS products. Advertising on television and radio has been prohibited for cigarettes and smokeless tobacco for decades, however, promotion of ENDS products on television and radio is not currently prohibited. Although the 2016 Deeming Regulation extended the U.S. Food and Drug Administration’s regulatory authority to all tobacco products, including ENDS, the rule does not prohibit advertising (Food and Administration, 2016). These results highlight how ENDS marketing in cable television, radio and print consumer magazines commonly includes flavor-related content. This type of marketing is a public health concern given the appeal of flavored ENDS to young people (Harrell et al., 2017; Huang et al., 2017; Zare et al., 2018) and the vulnerability of adolescents and young adults to nicotine addiction.

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## CRedit authorship contribution statement

**Lauren Czapllicki:** Conceptualization, Methodology, Formal analysis, Data curation, Writing – original draft, Writing – review & editing, Visualization. **Michelle Duren:** Writing – original draft, Writing – review & editing. **Dannielle Kelley:** Methodology, Project administration, Supervision, Writing – review & editing. **Meghan B. Moran:** Methodology, Writing – review & editing, Project administration. **Kevin Welding:** Data curation, Writing – review & editing. **Ryan David Kennedy:** Methodology, Project administration, Supervision, Funding acquisition, Writing – review & editing.

## Declaration of Competing Interest

Dr. Meghan B. Moran is a paid expert witness in litigation sponsored by the Public Health Advocacy Institute against RJ Reynolds. This arrangement has been reviewed and approved by the Johns Hopkins University in accordance with its conflict-of-interest policies. All other authors report no conflicts of interest.

## Data availability

The authors do not have permission to share data.

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