Original investigation

Engagement With Online Tobacco Marketing Among Adolescents in the United States: 2013–2014 to 2014–2015

Samir Soneji PhD^{1,2}, JaeWon Yang BA³, Meghan Bridgid Moran PhD⁴,
Andy S. L. Tan PhD, MPH, MBA, MBBS⁵, James Sargent MD^{1,2},
Kristin E. Knutzen MPH², Kelvin Choi PhD, MPH⁶

¹Dartmouth-Hitchcock Norris Cotton Cancer Center, Dartmouth Geisel School of Medicine, Lebanon, NH; ²The Dartmouth Institute for Health Policy and Clinical Practice, Dartmouth Geisel School of Medicine, Lebanon, NH; ³Warren Alpert Medical School of Brown University, Providence, RI; ⁴Department of Health, Behavior, and Society, Johns Hopkins University, Baltimore, MD; ⁵Department of Social and Behavioral Sciences, Harvard T.H. Chan School of Public Health, Boston, MA; ⁶Division of Intramural Research, National Institute on Minority Health and Health Disparities, Bethesda, MD

Corresponding Author: Samir Soneji, PhD, The Dartmouth Institute for Health Policy and Clinical Practice, Dartmouth Geisel School of Medicine, One Medical Center Drive, Lebanon, NH 03756, USA. E-mail: samir.soneji@dartmouth.edu

Abstract

Objective: To assess changes in engagement with online tobacco and electronic cigarette (e-cigarette) marketing (online tobacco marketing) among adolescents in the United States between 2013 and 2015.

Methods: We assessed the prevalence of six forms of engagement with online tobacco marketing, both overall and by brand, among adolescents sampled in Wave 1 (2013–2014; $n = 13\,651$) and Wave 2 (2014–2015; $n = 12\,172$) of the nationally representative Population Assessment for Tobacco and Health Study. Engagement was analyzed by tobacco use status: non-susceptible never tobacco users; susceptible never tobacco users; ever tobacco users, but not within the past year; and past-year tobacco users.

Results: Among all adolescents, the estimated prevalence of engagement with at least one form of online tobacco marketing increased from 8.7% in 2013–2014 to 20.9% in 2014–2015. The estimated prevalence of engagement also increased over time across all tobacco use statuses (eg, from 10.5% to 26.6% among susceptible adolescents). Brand-specific engagement increased over time for cigarette, cigar, and e-cigarette brands.

Conclusion: Engagement with online tobacco marketing, both for tobacco and e-cigarettes, increased almost twofold over time. This increase emphasizes the dynamic nature of online tobacco marketing and its ability to reach youth. The Food and Drug Administration, in cooperation with social networking sites, should consider new approaches to regulate this novel form of marketing.

Implications: This is the first study to estimate the national prevalence of engagement with online tobacco marketing among adolescents over time. The estimated prevalence of this engagement approximately doubled between 2013–2014 and 2014–2015 among all adolescents and, notably, among adolescents at relatively low risk to initiate tobacco use. This increase in engagement could represent public health harm if it results in increased initiation and use of tobacco products. Stronger federal regulation of online tobacco marketing and tighter control of access to tobacco-related content by social media sites could reduce adolescents' exposure to and engagement with online tobacco marketing.

Introduction

Traditional marketing by the tobacco industry (eg, print advertisements) leads to adolescent tobacco use.¹ The 1998 Master Settlement Agreement (MSA) directly addressed some aspects of traditional tobacco marketing including restrictions on youth-targeted advertising and product placement in entertainment media. However, the MSA did not address online tobacco marketing. The 2009 Family Smoking Prevention and Tobacco Control Act (Tobacco Control Act) established additional advertising and marketing regulations; however, it too did not directly address online tobacco marketing. Since the MSA and passage of the Tobacco Control Act, the tobacco industry has shifted expenditure away from traditional marketing and toward online marketing.^{2–4} Electronic cigarette (e-cigarette) marketing—both from tobacco companies with e-cigarette brands and independent e-cigarette companies—has also increased since 2011 and now includes a heavy presence online.⁵

Online tobacco and e-cigarette marketing (hereafter, *online tobacco marketing*) may be more effective than traditional (offline) marketing in promoting adolescent use by providing greater interaction with protobacco content.^{6–8} In 2013–2014, an estimated 12% of adolescents in the United States—or ~2.9 million—engaged with at least one form of online tobacco marketing including signing up for E-mails, reading tobacco-related articles, and watching tobacco-related videos.⁹ Moreover, Soneji et al. (2018) found engagement with online tobacco marketing was positively associated with tobacco use initiation, increased frequency of tobacco use, and progression to polytobacco product use among prior tobacco users, and negatively associated with tobacco use cessation in a national longitudinal study of adolescents.¹⁰

We do not know whether the prevalence of engagement with online tobacco marketing has changed among adolescents in the United States in subsequent years, or whether any potential change differs by tobacco use category. We address this research gap by calculating the prevalence of online tobacco marketing engagement between 2013–2014 and 2014–2015 among adolescents by tobacco use status (ever used and never used) and susceptibility to tobacco use.

Methods

Sample

We utilized data from Wave 1 (2013–2014; $n = 13\,651$) and Wave 2 (2014–2015 $n = 12\,172$) of the nationally representative Population Assessment for Tobacco and Health (PATH) Study, Adolescent Sample. Recruitment for the PATH Study employed address-based, area-probability sampling with an in-person household screener to select youths and adults. Of the 13 651 adolescents (aged 12–17 years old) sampled in Wave 1, 10 081 remained adolescents in Wave 2 (74%), 1915 aged into the adult sample (14%), and 1655 were lost to follow-up (12%). To replenish the sample from attrition, the PATH Study added 2091 children from sampled households who became 12 years old by the time of Wave 2 survey.^{11,12} The PATH Study used audio, computer-assisted self-interviews available in English and Spanish to collect information on tobacco use patterns. The weighting procedure employed by the PATH Study adjusted for over-sampling and nonresponse. The weighted data, in conjunction with the use of a probability sample, enable estimated prevalence values to be representative of the civilian noninstitutionalized US population. Further details regarding the PATH Study were published by Hyland et al.¹³

Measures

We included the following types of tobacco products: cigarettes, e-cigarettes, cigars (traditional cigars, cigarillos, and little filtered cigars), hookah, pipe, snus pouches, and other smokeless tobacco, dissolvable tobacco, bidi (hand-rolled, flavored cigarettes), and kretek (clove cigarettes). E-cigarettes were considered to be a tobacco product because the Food and Drug Administration (FDA) deemed e-cigarettes under its regulatory authority for tobacco products in 2016.¹⁴ We categorized respondents into the following tobacco use categories: (1) non-susceptible never tobacco users (non-susceptible); (2) susceptible never tobacco users (susceptible); (3) ever tobacco users, but not within the past year (non-past year); and (4) ever tobacco users, within the past year (past year). We considered never tobacco users susceptible to tobacco use if they responded “definitely yes,” “probably yes,” or “probably no” to at least one of the following questions for one or more products: (1) “If one of your friends offered you a (cigarette/e-cigarette/etc.), would you try it?” (2) “Do you think you will smoke a (cigarette/e-cigarette/etc.) sometime in the next year?” and (3) “Have you ever been curious about smoking/using a (cigarette/e-cigarette/etc.)?”¹⁵

In this analysis, we investigated engagement with six forms of online tobacco marketing that were included in both Waves 1 and 2 of the PATH Study: (1) signing up for E-mail alerts, reading articles online, or watching videos online about tobacco products; (2) liking or following a tobacco brand on social media; (3) sending a tobacco brand link or information on social media sites; (4) playing online games related to tobacco brands; (5) receiving discount coupons electronically; and (6) receiving tobacco-related information electronically (see [Supplementary Table 1](#) for survey question text of each form of engagement). We also examined brand-specific forms of engagement with the five brands (Camel, Marlboro, Newport, Swisher, and Blu) that were queried in both Waves 1 and 2 of the PATH Study. Although respondents were also queried on the brands Fin, Vuse, and NJOY in Wave 2, they were not queried on these brands in Wave 1; thus, these brands were not included in the analysis. The cigarette (Camel, Marlboro, and Newport) and cigar (Swisher) brands included in the PATH Study Wave 1 had the greatest market share as well as the heaviest advertising at the time of the study; the e-cigarette brand (Blu) was also one of the top selling e-cigarette brands at the time.^{16,17} We also examined receipt of discount coupons and tobacco-related information by specific channels: E-mail, Internet, social networking sites, and text message. For each form of engagement, respondents could have engaged with multiple brands or through multiple channels.

We did not consider engagement via (1) visiting a tobacco brand Web site or (2) registering on a tobacco brand Web site, because they were only assessed in Wave 1. We also did not consider engagement via (3) scanning a quick response (QR) code for a sweepstakes drawing or (4) scanning a QR code that took the respondent to a tobacco company Web site, because they were only assessed among new respondents in Wave 2. However, we report the estimated prevalence for these two QR-related forms of engagement among all Wave 1 respondents and new Wave 2 respondents ([Supplementary Table 1](#)).

Analysis

First, we estimated the weighted proportion of respondents by age group, sex, race (White, Black, Other), Hispanic ethnicity, and tobacco use status in Wave 1 and Wave 2. We assessed statistically significant differences in the proportion of non-susceptible and susceptible respondents between Wave 1 and Wave 2 by utilizing a

weighted *t* test of proportions. Second, we estimated the weighted prevalence of affirmative responses of each form of engagement with online tobacco marketing among all respondents and stratified by tobacco use category in Wave 1 and Wave 2. Third, we estimated the weighted prevalence of brand- and modality-specific forms of engagement with online tobacco marketing among all respondents in Wave 1 and Wave 2. For both steps two and three, we assessed statistically significant differences in the estimated prevalence by utilizing a weighted *t* test of proportions.

Finally, we estimated the weighted prevalence of ambiguous responses to engagement with online tobacco marketing (ie, do not know). Throughout the analysis, we utilized balanced repeated replication weights with Fay's correction (shrinkage factor set at 0.3).

Ethical Approval

The PATH Study design and procedures were approved by the Westat Institutional Review Board,¹³ and the Dartmouth College Committee for the Protection of Human Subjects deemed institutional review board review unnecessary for this secondary analysis of PATH data because it did not meet the regulatory definition of human subjects research (45 CFR 46.102[f]).

Results

Sample Characteristics

The Wave 1 sample was ~51.3% male, 70.7% White and 15.2% Black, and 22.3% Hispanic (Table 1). The Wave 2 sample was nearly identical in its demographic composition: 51.3% male, 69.7% White and 15.7% Black, and 23.1% Hispanic. The prevalence of non-susceptible adolescents increased from an estimated 44.1% in Wave 1 to 46.8% in Wave 2 ($p < .01$) while the prevalence of susceptible adolescents decreased from an estimated 34.1% in Wave 1 to 30.8% in Wave 2 ($p < .01$).

Prevalence of Engagement With Online Marketing

Among all adolescents, the estimated prevalence of engagement with at least one form of online tobacco marketing increased from

8.7% in Wave 1 to 20.9% in Wave 2 (Table 2; $p < .01$). The estimated prevalence increased over time from 7.8% to 18.1% among 12- to 14-year-olds ($p < .01$) and from 9.6% to 23.8% among 15- to 17-year-olds ($p < .01$; Supplementary Table 2). Finally, a small proportion of adolescents did not know whether they had engaged with online tobacco marketing. For example, an estimated 0.3% and 0.7% of adolescents did not know whether they had liked or followed a tobacco brand on a social media site in Wave 1 and Wave 2 respectively (Supplementary Table 3).

Engagement Changes by Tobacco Use Status

Between Wave 1 and Wave 2, the estimated prevalence of engagement with at least one form of online tobacco marketing increased from 4.7% to 11.9% among non-susceptible adolescents ($p < .01$), and from 10.5% to 26.6% among susceptible adolescents ($p < .01$; Table 2). We observed a similar pattern among adolescents who were ever tobacco users. Between Wave 1 and Wave 2, the estimated prevalence of engagement with at least one form of online tobacco marketing increased from 12.7% to 25.6% among non-past-year users ($p < .01$), and from 14.7% to 40.4% among past-year users ($p < .01$). The leading form of engagement across all tobacco use categories was signing up for E-mail alerts, reading tobacco-related online articles, or watching tobacco-related online videos: 4.6% at Wave 1 and 13.8% at Wave 2 ($p < .01$).

Engagement by Brand

The estimated prevalence of engagement by brand increased between Wave 1 and Wave 2 for the three forms of brand-specific online tobacco marketing (Figure 1). For example, the estimated prevalence of liking or following the following brands on social media increased between Wave 1 and Wave 2: 0.5% to 2.0% for Camel, 0.4% to 2.1% for Marlboro, 0.4% to 1.8% for Newport, 0.5% to 2.3% for Swisher, and 0.4% to 2.4% for Blu ($p < .01$ for each brand). The estimated prevalence also increased between Wave 1 and Wave 2 for each brand for sending a link or information on social media sites and playing an online game ($p < .01$ for each brand).

Table 1. Weighted Prevalence of Demographic Characteristics and Tobacco Use Status

Variable	Wave 1 ($n = 13\,651$) Pt. Est. (95% CI)	Wave 2 ($n = 12\,172$) Pt. Est. (95% CI)
Age group (years)		
12–14	50.4% (49.5%, 51.3%)	50.7% (49.8%, 51.6%)
15–17	49.6% (48.7%, 50.4%)	49.3% (48.4%, 50.2%)
Sex		
Male	51.3% (50.4%, 52.2%)	51.3% (50.3%, 52.2%)
Female	48.7% (47.8%, 49.6%)	48.7% (47.8%, 49.7%)
Race/Ethnicity		
White	70.7% (69.9%, 71.5%)	69.7% (68.8%, 70.6%)
Black	15.2% (14.6%, 15.9%)	15.7% (15.0%, 16.4%)
Other	14.1% (13.5%, 14.7%)	14.6% (13.9%, 15.3%)
Hispanic origin		
Hispanic	22.3% (21.6%, 22.9%)	23.1% (22.3%, 23.8%)
Non-Hispanic	77.7% (77.0%, 78.4%)	76.9% (76.2%, 77.7%)
Tobacco use category		
Never tobacco use, not susceptible	44.1% (43.2%, 45.0%)	46.8% (45.8%, 47.8%)
Never tobacco use, susceptible	34.1% (33.3%, 35.0%)	30.8% (29.9%, 31.7%)
Ever tobacco use, not past year	5.1% (4.7%, 5.5%)	19.9% (19.1%, 20.7%)
Ever tobacco use, past year	16.7% (16.0%, 17.4%)	2.4% (2.1%, 2.7%)

Weighted prevalence for each variable or tobacco use category may not add to 100% because of rounding. Pt. Est. = point estimate; CI = confidence interval.

Table 2. Weighted Prevalence of Online Engagement by Tobacco Use Category: Wave 1 (2013–2014) and Wave 2 (2014–2015)

	All respondents			Never tobacco users, non-susceptible			Never tobacco users, susceptible			Ever tobacco users, not past year			Past-year tobacco users		
	2013–2014	2014–2015	% (95% CI)	2013–2014	2014–2015	% (95% CI)	2013–2014	2014–2015	% (95% CI)	2013–2014	2014–2015	% (95% CI)	2013–2014	2014–2015	% (95% CI)
Form of engagement ^a															
E-mail alerts, read articles, watched videos (in past 6 months, 2013–2014; in past 12 months, 2014–2015)	4.6 (4.2%, 4.9%)	13.8 (13.1%, 14.5%)**		3.2 (2.7%, 3.7%)	8.5 (7.6%, 9.3%)**		6.0 (5.2%, 6.7%)	19.2 (17.8%, 20.7%)**		4.9 (3.1%, 6.6%)	17.5 (15.8%, 19.2%)**		5.2 (4.2%, 6.2%)	20.3% (15.1%, 25.6%)**	
Liked or followed (ever, 2013–2014; past 12 months, 2014–2015)	1.5 (1.3%, 1.7%)	5.2 (4.8%, 5.6%)**		0.3 (0.1%, 0.4%)	1.6 (1.3%, 2.0%)**		0.9 (0.6%, 1.2%)	4.6 (3.9%, 5.4%)**		2.3 (1.2%, 3.4%)	11.9 (10.5%, 13.3%)**		5.6 (4.6%, 6.5%)	23.2% (17.9%, 28.4%)**	
Sent a link or information on social media sites (ever, 2013–2014; past 12 months, 2014–2015)	0.8 (0.7%, 1.0%)	2.5 (2.2%, 2.8%)**		0.2 (0.1%, 0.3%)	0.9 (0.7%, 1.2%)**		0.8 (0.5%, 1.0%)	2.3 (1.8%, 2.9%)**		1.6 (0.6%, 2.6%)	5.9 (4.9%, 6.9%)**		2.4 (1.8%, 3.1%)	8.8% (5.5%, 12.1%)**	
Played online game (ever, 2013–2014; past 12 months, 2014–2015)	1.1 (0.9%, 1.3%)	2.7 (2.4%, 3.0%)**		0.3 (0.1%, 0.4%)	1.2 (0.8%, 1.5%)**		1.2 (0.9%, 1.6%)	3.4 (2.7%, 4.0%)**		3.8 (2.3%, 5.3%)	4.9 (4.0%, 5.9%)		2.1 (1.6%, 2.7%)	6.9% (3.9%, 9.9%)**	
Received discount coupon electronically (past 6 months, 2013–2014; past 30 days, 2014–2015)	2.2 (2.0%, 2.5%)	2.8 (2.4%, 3.1%)**		1.1 (0.8%, 1.3%)	1.2 (0.9%, 1.5%)		2.8 (2.3%, 3.3%)	3.8 (3.1%, 4.5%)*		3.8 (2.3%, 5.2%)	4.2 (3.4%, 5.1%)		4.0 (3.1%, 4.8%)	6.5% (3.6%, 9.5%)	
Received tobacco-related information electronically (past 6 months, 2013–2014; past 30 days, 2014–2015)	0.8 (0.6%, 0.9%)	1.4 (1.2%, 1.7%)**		0.2 (0.1%, 0.4%)	0.8 (0.5%, 1.0%)**		0.9 (0.7%, 1.2%)	1.8 (1.3%, 2.3%)**		1.9 (0.9%, 3.0%)	2.2 (1.6%, 2.9%)		1.4 (0.9%, 1.9%)	5.8% (3.0%, 8.6%)**	
Engagement with ≥1 form	8.7 (8.2%, 9.2%)	20.9 (20.1%, 21.7%)**		4.7 (4.2%, 5.3%)	11.9 (11.0%, 12.9%)**		10.5 (9.5%, 11.4%)	26.6 (25.1%, 28.2%)**		12.7 (10.1%, 15.4%)	31.0 (28.9%, 33.0%)**		14.7 (13.1%, 16.2%)	40.4% (34.2%, 46.6%)**	

CI = confidence interval.

^aSee [Supplementary Table 4](#), for survey question text of each form of engagement with online tobacco marketing for both waves.* $p < .05$ and ** $p < .01$ from weighted t test of a difference in proportions between Wave 1 and Wave 2 for all respondents and for each tobacco use status.

Figure 1. Prevalence of online engagement by tobacco brand and modality, 2013–2014 and 2014–2015. * $p < .05$ and ** $p < .01$ from weighted t test of a difference in proportions between Wave 1 and Wave 2.

Engagement by Modality

The estimated prevalence of receiving a discount coupon via E-mail increased between Wave 1 and Wave 2: 1.0% to 1.3% ($p < .05$). The estimated prevalence of receiving a discount coupon via the Internet also increased between the two waves: 1.5% to 1.9% ($p < .05$). In addition, the estimated prevalence increased between the Waves for receiving tobacco-related information via E-mail (0.4% to 0.6%, $p < .01$), the Internet (0.4% to 0.7%, $p < .01$), and social media sites (0.3% to 0.6%, $p < .01$).

Discussion

Our study found a substantial increase in engagement with online tobacco marketing among all adolescents: from an estimated 8.7% in 2013–2014 to 20.9% in 2014–2015. This growth translates to an increase from an estimated 2.2 million adolescents who engaged in online tobacco marketing in 2013–2014 to 5.2 million adolescents in 2014–2015. We also found at least a twofold increase in such engagement across all tobacco use categories. Brand-specific engagement with online tobacco marketing also increased two- to

fourfold over this time period for leading cigarette, cigar, and e-cigarette brands.

The increase in the estimated prevalence of engagement with online tobacco marketing between 2013–2014 and 2014–2015 may have occurred because of greater expenditure on marketing and advertising by the tobacco industry, for both cigarettes and e-cigarettes. Earlier studies found a substantial increase in e-cigarette advertising, both offline and online, between 2011 and 2014.^{18–20} If advertising expenditure remained proportional to sales, which rose in both years, then e-cigarette advertising may have continued to increase in 2014 and 2015.²¹ Advertising expenditure on cigarette brand Web sites also increased from 15.7 million dollars in 2013 to 27.6 million dollars in 2015 (a 76% relative increase; both expenditures in 2015 dollars).²² In contrast, the estimated prevalence of engagement likely did not increase over time because of an age effect. The age distributions of the Wave 1 and Wave 2 PATH adolescent sample were virtually identical, and the prevalence of engagement with online tobacco marketing increased over time for both younger and older adolescents.

The temporal increase in brand-specific forms of engagement with online tobacco marketing may pose a public health harm to adolescents. This increase suggests that advertising and promotion efforts by tobacco and e-cigarette companies have successfully raised brand awareness that, in turn, could lead to more favorable attitudes toward tobacco and e-cigarette use.^{1,23,24} Despite restrictions in traditional marketing channels, cigarette-brand-specific forms of engagement with online tobacco marketing still increased over time. Thus, online marketing channels (eg, social networking sites and tobacco company Web sites) offer a platform for adolescents to be exposed to and engage with their peers on traditional and harmful combustible tobacco products.

Our study may have underestimated the level of engagement with online tobacco marketing because some adolescents may engage without realizing it. Marketing firms—in partnership with leading alcohol and entertainment companies—now utilize neuro-marketing strategies including eye-tracking, functional magnetic resonance imaging, and electroencephalography studies to enhance marketing effectiveness.²⁵ The goal of these contemporary strategies is consumer engagement, which the Advertising Research Foundation describes as a “subtle, subconscious process in which consumers begin to combine the ad’s messages with their own associations, symbols and metaphors to make the brand more personally relevant.”^{26,27} Similarly, tobacco companies have utilized neuro-marketing strategies to evaluate product characteristics and appeal of advertising campaigns.^{28–30} This utilization, in combination with the unregulated nature of online tobacco marketing, may lead adolescents to passively engage with online tobacco marketing through their routine use of the Internet, though they may not consciously recall this engagement. The recent repeal of net neutrality (a principle by which Internet service providers treat all Internet traffic equally)^{31,32} may exacerbate this problem by enabling tobacco companies to purchase Internet ads more effectively and target those ads more directly.³³

Stronger federal regulation of online tobacco marketing, such as a prohibition of e-cigarette advertising identical to existing prohibitions of cigarette advertising, could reduce adolescent engagement with online tobacco marketing.³⁴ The Federal Trade Commission (FTC) could more stringently enforce online tobacco marketing by issuing formal complaints and pursuing legal action against US-based tobacco companies for deceptive marketing practices. The

FTC could also pursue legal action against foreign-based tobacco companies for fraudulent advertising and marketing under its authority from the US Safe Web Act of 2006. Yet, federal regulation may prove difficult because of ongoing and future legal hurdles. For example, the Tobacco Control Act stipulated several marketing and advertising regulations, including changes to health warnings on tobacco products and prohibition of unsubstantiated health claims about reduced risk products. However, several of these marketing regulations were either struck down by the United States Courts (eg, *R.J. Reynolds Tobacco Co. v. U.S. Food & Drug Administration*) or are currently contested.^{35–37}

Federal regulation of online tobacco marketing may also prove difficult because of the legal protection of third-party speech in earned media (ie, user-generated branding and user-created content on social media sites). Brand narratives of many leading e-cigarette brands are coproduced on social media sites by both e-cigarette companies that post commercial content and users who post their own organically created content, as well as repost this commercial content.³⁸ The 1996 Communications Decency Act shields social media sites from liability over third-party speech, such as user-created content.³⁹ However, a large proportion of tobacco-related user-generated branding and user-created content may actually be commercial speech, including content generated by commercial bots.^{40–42} Unlike noncommercial speech, commercial speech is entitled to less than full First Amendment protection.⁴³ Social media sites could independently address fraudulent marketing by detecting and removing bots for violating terms of service.

Social media sites could also consistently apply their stated terms of service and policies that prohibit tobacco product advertising and marketing across all parts of their site. Facebook, for example, prohibits advertisements for tobacco products on the news feed page, but these restrictions do not apply to tobacco companies’ Facebook pages. The Facebook Advertising Policies Web site states “Ads must not promote the sale or use of tobacco products and related paraphernalia” and even includes an image of a woman using an e-cigarette with the caption “This image promotes an e-cigarette and is non-compliant.”⁴⁴ Yet, prominent e-cigarette brands have official Facebook Retail Company business pages (eg, Blu) that feature images and videos of individuals using e-cigarettes.⁴⁵ Finally, social media sites could utilize third-party age verification—as recommended by the FTC for online alcohol marketing—to reduce adolescents’ engagement with online tobacco marketing.⁴⁶

We note several important limitations of our study. The PATH Study changed its assessment of engagement with online tobacco marketing in several ways. First, the time interval in the survey measures changed for several forms of engagement. For example, the study asked respondents whether they received E-mail alerts, read tobacco-related articles online, or watched tobacco-related videos online within the past 6 months in Wave 1 and within the past 12 months in Wave 2. Thus, our study may have underestimated the prevalence of this form of engagement at Wave 1 and, therefore, overestimated its change over time. Second, our study may have overestimated the increase in engagement for e-cigarettes from E-mail alerts, reading articles, or watching videos, as the Wave 2 survey question explicitly prompted respondents to consider e-cigarettes, whereas the Wave 1 survey question did not. Third, our study may have underestimated engagement with online tobacco marketing on social media sites because the PATH Study survey items included sites (Facebook and Twitter) while other sites (eg, Instagram and Snapchat) were included as a residual category (“...or other sites”). Yet, the popularity of some

of the latter sites has grown over time.⁴⁷ Fourth, our study may conservatively estimate engagement because the PATH Study surveyed engagement with five specific brands (Camel, Marlboro, Newport, Swisher, and Blu), while other brands were not included. Thus, we could not assess the level of engagement for all tobacco brands over time, especially brands with a relatively high rate of youth usage (eg, Fin). Finally, our study did not assess the intensity and frequency of engagement with online tobacco marketing.

In conclusion, this nationally representative study is the first of its kind to assess the prevalence of engagement with online tobacco marketing among adolescents over time. We found that the estimated prevalence of such engagement increased by more than twofold among adolescents between 2013–2014 and 2014–2015. Limiting future potential harms from online tobacco marketing will require stronger oversight by regulatory authorities of online tobacco marketing and greater cooperation from social media sites to limit adolescents' access to this marketing.

Supplementary Material

Supplementary data can be found online at <http://www.ntr.oxford-journals.org>.

Funding

This work was supported by the National Cancer Institute at the National Institutes of Health (NIH) (R21-CA197912 to SS and R01-CA077026 to JS). MBM's effort is supported by National Institute on Drug Abuse and the FDA Center for Tobacco Products (CTP). ASLT's effort is supported by the National Cancer Institute and FDA CTP (R03 CA212544). KC's effort is supported by the Division of Intramural Research, the National Institute on Minority Health and Health Disparities. The content was solely the responsibility of the authors and did not necessarily represent the official views of the NIH or the FDA. The views and opinions expressed in this manuscript were those of the authors only and did not necessarily represent the views, official policy, or position of the National Institute on Minority Health and Health Disparities, the NIH, the US Department of Health and Human Services, or the US government.

Declaration of Interests

None declared.

References

- US Department of Health and Human Services. *Preventing Tobacco Use among Youth and Young Adults: A Report of the Surgeon General*. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2012.
- Lewis MJ, Yulis SG, Delnevo C, Hrywna M. Tobacco industry direct marketing after the master settlement agreement. *Health Promot Pract*. 2004;5(suppl 3):75S–83S.
- Federal Trade Commission. *Federal Trade Commission Cigarette Report for 2014*. 2016. <http://tinyurl.com/y76ysjbn>. Accessed July 10, 2017.
- Federal Trade Commission. *Federal Trade Commission Smokeless Tobacco Report for 2014*. 2016. <http://tinyurl.com/ydhj6tln>. Accessed July 10, 2017.
- Klein EG, Berman M, Hemmerich N, Carlson C, Htut S, Slater M. Online E-cigarette marketing claims: a systematic content and legal analysis. *Tob Regul Sci*. 2016;2(3):252–262.
- Ribisl KM. The potential of the internet as a medium to encourage and discourage youth tobacco use. *Tob Control*. 2003;12(suppl 1):i48–i59.
- Freeman B, Chapman S. Open source marketing: camel cigarette brand marketing in the “Web 2.0” world. *Tob Control*. 2009;18(3):212–217.
- Calder BJ, Malthouse EC, Schaedel U. An experimental study of the relationship between online engagement and advertising effectiveness. *J Interact Mark*. 2009;23(4):321–331.
- Soneji S, Pierce JP, Choi K, et al. Engagement with online tobacco marketing and associations with tobacco product use among U.S. youth. *J Adolesc Health*. 2017;61(1):61–69.
- Soneji S, Yang J, Knutzen KE, et al. Online tobacco marketing and subsequent tobacco use. *Pediatrics*. 2018;141(2):e20172927.
- Kalton G. *Some Issues in the Design and Analysis of Longitudinal Surveys*. Rockville, MD: Westat; 2013.
- Conway K. *Supporting Statement B for Population Assessment of Tobacco and Health (PATH) Study (NIDA)—Third Wave of Data Collection*. Rockville, MD: National Institute on Drug Abuse; 2015.
- Hyland A, Ambrose BK, Conway KP, et al. Design and methods of the Population Assessment of Tobacco and Health (PATH) Study. *Tob Control*. 2017;26(4):371–378.
- Food and Drug Administration. *Federal Register | Deeming Tobacco Products To Be Subject to the Federal Food, Drug, and Cosmetic Act, as Amended by the Family Smoking Prevention and Tobacco Control Act; Restrictions on the Sale and Distribution of Tobacco Products and Required Warning Statements for Tobacco Products*. 2016. <https://www.federalregister.gov/articles/2016/05/10/2016-10685/deeming-tobacco-products-to-be-subject-to-the-federal-food-drug-and-cosmetic-act-as-amended-by-the>. Accessed August 22, 2016.
- Strong DR, Hartman SJ, Nodora J, et al. Predictive validity of the expanded susceptibility to smoke index. *Nicotine Tob Res*. 2015;17(7):862–869.
- Centers for Disease Control and Prevention (CDC). Tobacco Brand Preferences. Smoking & Tobacco Use. 2017. http://www.cdc.gov/tobacco/data_statistics/fact_sheets/smokeless/betel_quid/. Accessed January 3, 2018.
- CSP. U.S. e-cigarettes Brands Market Share C-stores. 2016. Statista. www.statista.com/statistics/285116/us-e-cigarettes-companies-trend-in-market-share/. Accessed January 3, 2018.
- Kim AE, Arnold KY, Makarenko O. E-cigarette advertising expenditures in the U.S., 2011–2012. *Am J Prev Med*. 2014;46(4):409–412.
- Truth Initiative. *Vaporized: Youth and Young Adult Exposure to E-Cigarette Marketing*. Truth Initiative; 2015. <https://truthinitiative.org/sites/default/files/Vaporized-Youth-Exposure-To-E-Cigarette-Marketing.pdf>. Accessed September 28, 2017.
- Singh T, Marynak K, Arrazola R, Cox S, Rolle I, King B. Vital signs: exposure to electronic cigarette advertising among middle school and high school students—United States, 2014. *MMWR Morb Mortal Wkly Rep*. 2016;64(52):1403–1408.
- Statista. *Electronic Cigarettes (E-Cigarettes) Dollar Sales in the United States from 2014–2018 (in Billion U.S. Dollars)*. 2017. <https://www.statista.com/statistics/285143/us-e-cigarettes-dollar-sales/>. Accessed September 27, 2017.
- Federal Trade Commission. *Federal Trade Commission Cigarette Report for 2015*. Washington DC: Federal Trade Commission; 2017. <https://www.ftc.gov/reports/federal-trade-commission-cigarette-report-2013>. Accessed January 5, 2018.
- Aitken PP, Leather DS, O'Hagan FJ, Squair SI. Children's awareness of cigarette advertisements and brand imagery. *Br J Addict*. 1987;82(6):615–622.
- DiFranza, J. The effects of tobacco advertising on children. In: Slama K, ed. *Tobacco and Health: Proceedings from the 9th World Conference on Tobacco and Health*. New York: Plenum Press; 1995:87–90.
- Chester J, Montgomery K, Dorfman L. *Alcohol Marketing in the Digital Age*. Berkeley Media Studies Group, Public Health Institute; 2010. www.phi.org/uploads/application/files/x5h84kow9rog25u7ortly59nt-6spre8xnytrdoolpx3dvud46d.pdf.
- Nail J. The 4 Types of Engagement. <http://www.imediaconnection.com/article/139670/the-4-types-of-engagement>. Accessed September 29, 2017.
- Montgomery KC, Chester J. Interactive food and beverage marketing: targeting adolescents in the digital age. *J Adolesc Health*. 2009;45(suppl 3):S18–S29.
- O'Neill M. CARLTON—Eye-Tracking/Portfolio Study. 1988. <https://www.industrydocumentslibrary.ucsf.edu/tobacco/docs/#id=rgcd0141>. Accessed January 4, 2018.

29. Mitchell C. ECLIPSE Print CopyLab and Eye-Tracking Study. 2000. <https://www.industrydocumentslibrary.ucsf.edu/tobacco/docs/#id=hngn0221>. Accessed January 5, 2018.
30. Panzano VC, Wayne GF, Pickworth WB, Connolly GN. Human electroencephalography and the tobacco industry: a review of internal documents. *Tob Control*. 2010;19(2):153–159.
31. Wu T. Network neutrality, broadband discrimination. *J Telecommun High Technol Law*. 2003;2:141–176.
32. Lee TB. What is network neutrality? Vox. 2014. <https://www.vox.com/cards/network-neutrality/whats-network-neutrality>. Accessed February 25, 2018.
33. Palmer S. The end of net neutrality could be good for marketers—and bad for almost everyone else. AdAge. 2017. <http://adage.com/article/opinion/end-net-neutrality-good-advertisers/311399/>. Accessed January 4, 2018.
34. Escobedo P, Cruz TB, Tsai K-Y, et al. Monitoring tobacco brand websites to understand marketing strategies aimed at tobacco product users and potential users. *Nicotine Tob Res*. doi:10.1093/ntr/ntx200
35. R.J. Reynolds Tobacco Co. v. Food & Drug Administration. *Harv Law Rev*. 2013;126(3):818825.
36. Cortez N. Do graphic tobacco warnings violate the first amendment? *Hastings Law J*. 2013;64(5):1467–1500.
37. Lindblom EN, Berman ML, Thrasher JF. FDA-Required tobacco product inserts & onsets—and the first amendment. *Food Drug Law J*. 2017;72(1):1–25.
38. Allem JP, Ferrara E, Uppu SP, Cruz TB, Unger JB. E-Cigarette surveillance with social media data: social bots, emerging topics, and trends. *JMIR Public Health Surveill*. 2017;3(4):e98.
39. Ardia DS. Free speech savior or shield for scoundrels: an empirical study of intermediary immunity under Section 230 of the Communications Decency Act. *Loyola Los Angel Law Rev*. 2009;43:373–506.
40. Huang J, Kornfield R, Szczypka G, Emery SL. A cross-sectional examination of marketing of electronic cigarettes on Twitter. *Tob Control*. 2014;23(suppl 3):iii26–iii30.
41. Kim AE, Hopper T, Simpson S, et al. Using twitter data to gain insights into E-cigarette marketing and locations of use: an infoveillance study. *J Med Internet Res*. 2015;17(11):e251.
42. Clark EM, Jones CA, Williams JR, et al. Vaporous marketing: uncovering pervasive electronic cigarette advertisements on twitter. *PLoS One*. 2016;11(7):e0157304.
43. Redish MH, Voils K. False commercial speech and the first amendment: understanding the implications of the equivalency principle symposium: commercial speech and the first amendment: past, present, and future. *William Mary Bill Rights J*. 2016;25(3):765–800.
44. Facebook. Advertising Policies, Prohibited Content, Tobacco Products. 2017. https://www.facebook.com/policies/ads/prohibited_content/tobacco#. Accessed October 3, 2017.
45. blu. Facebook. https://www.facebook.com/blucigsusa/?ref=br_rs. Accessed January 9, 2018.
46. Evans J, Krainsky E, Fentonmiller K, Brady C, Yoeli E, Jaroszewicz A. *Self-Regulation in the Alcohol Industry Report of the Federal Trade Commission*. Washington DC: Federal Trade Commission; 2014.
47. Statista. *Most Popular Social Networks and Apps According to Teen Social Media Users in the United States as of November 2016, Based on Daily Usage*; 2017. <https://www.statista.com/statistics/306947/us-teens-social-media-apps-dau/>. Accessed September 27, 2017.