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The magnitude and impact of tobacco marketing exposure in adolescents' day-to-day lives: An ecological momentary assessment (EMA) study

Megan E. Roberts, PhD^a, Brittney Keller-Hamilton, MPH^a, Alice Hinton, PhD^a, Christopher R. Browning, PhD^b, Michael D. Slater, PhD^c, Wenna Xi, MS^a, Amy K. Ferketich, PhD^a

^aCollege of Public Health, The Ohio State University, Columbus, OH

^bDepartment of Sociology, The Ohio State University, Columbus, OH

^cSchool of Communication, The Ohio State University, Columbus, OH

Abstract

Purpose: Research indicates that tobacco marketing contributes to higher pro-tobacco attitudes and behaviors among adolescents, but no studies have been able to assess the impact of real-world tobacco marketing exposures in real-time. The purpose of this study was to examine the magnitude and impact of tobacco marketing exposure on adolescents using ecological momentary assessment (EMA). Our primary hypotheses were that (1) youth would most frequently report tobacco marketing at the retail points-of-sale and (2) greater exposures to tobacco marketing would be associated with more favorable tobacco-related attitudes, use, and expectancies.

Methods: Participants were adolescent males from rural and urban Ohio (N=176, ages 11–16). For ten days, these adolescents were prompted at two—three random times/day to complete a brief smartphone-based survey about their exposures and responses to tobacco-related advertising.

Results: Adolescents reported exposures to tobacco marketing an average of 1.9 times over the 10-day EMA period, with over 10% seeing a tobacco advertisement 5 or more times. Reports of marketing exposures occurred most frequently at the point-of-sale; exposures were higher among tobacco users and rural adolescents. Consistent with hypotheses, marketing exposure was related to more positive attitudes to the tobacco advertisements, more tobacco use, and higher expectancies to use in the future.

Conclusions: Overall, these findings signal the magnitude of tobacco marketing exposures and their pernicious impact on youth. Findings underscore the importance of federal, state, and local-level tobacco regulatory policies to protect youth from the marketing that puts them at risk for a lifetime of nicotine addiction and tobacco-related diseases.

Keywords

Adolescents; tobacco marketing; ecological momentary assessment (EMA)

Corresponding Author: Megan E. Roberts, The College of Public Health, The Ohio State University, Columbus, OH, 43210. Phone: (614) 292-4647 Fax: (614) 688-3533 Roberts.1558@osu.edu.

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Introduction

In recent decades, regulatory actions have established bans on cigarette and smokeless tobacco (SLT) advertising on television and radio.¹ Further, as part of the 1998 Master Settlement Agreement, tobacco companies were prohibited from most forms of billboard and transit advertising, as well as print advertising directed to underage youth.² A major intention of these restrictions was to reduce youth exposure to tobacco marketing. Yet as the tobacco industry currently spends over \$9 billion each year on tobacco marketing, including advertising at the retail point-of-sale and online,³ the magnitude and impact of tobacco marketing viewed by youth remains a worry.

Adolescent exposure to tobacco marketing is particularly concerning given that rates of overall tobacco use have not declined in the past five years.⁴ Specifically, although current cigarette use has decreased somewhat among high school students, the decline was offset by an increase in e-cigarette and hookah use. Currently, one in five high school students reports using a tobacco product within the past 30 days.⁴

Research on cigarette marketing indicates that, for youth, greater exposure increases perceptions about the availability and popularity of cigarettes,^{5,6} increases curiosity about cigarette use,⁷ and increases the likelihood of smoking initiation.^{8–12} There is likewise recent work showing that greater exposure to e-cigarette marketing is associated with susceptibility and use.^{13–15} This body of research has used a range of methods, including prospective surveys, assessments of retailer locations and advertising, and experimental manipulation. However, adolescent research has not been able to assess the impact of real-world tobacco marketing exposure in real-time. Ecological momentary assessment (EMA) is a method that can provide this information, by allowing for the real-time collection of data from people (typically, via their smartphone) as they go about their lives. EMA thus increases external validity while also reducing recall error—an advantage that is particularly important for adolescents.^{16–19} Specifically, rather than relying on teenagers to accurately recall details from the past week, EMA only requires teenagers to recall their last few hours.

The purpose of this study was to examine the magnitude and impact of tobacco marketing exposure on adolescents. We sought to obtain comprehensive information on all tobacco products advertised, including cigarettes, SLT, and e-cigarettes. In terms of the magnitude of tobacco marketing, we hypothesized that, consistent with the allocation of the tobacco industry's marketing expenses,³ youth would most frequently report tobacco marketing at the retail points-of-sale. We also hypothesized that the more vulnerable youth in our study—tobacco users and youth living in rural settings—would experience greater exposure to tobacco marketing. In terms of the impact of tobacco marketing, we hypothesized that greater exposures to tobacco marketing would be associated with more positive attitudes to the tobacco advertisements, more tobacco use, and higher expectancies to use in the future.

METHODS

Participants

Study methods were approved by the university IRB at the authors' institution. Participants in this study were drawn from a larger prospective cohort study examining adolescent tobacco use in urban and rural Ohio. SLT use was a major focus of this parent study; as SLT use is much more prevalent among males than females,^{4,20} only male adolescents (aged 11–16 years at baseline) were enrolled. For the present EMA study, all participants in the cohort panel who had indicated past-30-day use of a tobacco product at baseline or within the first year of the study were invited to enroll; a subsample of the non-users who were matched to a user on age and region of residence were also enrolled. Two-hundred and eleven participants completed the EMA protocol (described below). Data were excluded from those who had completed less than 50% of their assigned surveys and/or had substantial technical problems with the app (n=35), yielding a sample of 176 male adolescents for analyses. Analyses indicated that the 35 excluded participants did not differ from the final sample on SES, age, race/ethnicity, smoking status, or having an adult smoker in the home.

Procedures

For the main cohort study, participants were recruited through address-based probability sampling and non-probability community-based sampling. Adolescent data collection took place in-person during baseline and was via telephone during the 6-month and 12-month follow-up (additional waves of data collection are ongoing). A parent or guardian also completed a survey at baseline.

For the EMA, trained interviewers first met with participants and a parent or guardian in their home and obtained written consent/assent for the EMA portion of the study. Participants were encouraged to download the free EMA app onto their own smartphone if they owned one; participants without a smartphone were provided one for the study period. The app, PiLR EMA (MEI Research, Edina, MN, USA), was refined specifically for this study. The interviewer provided training on how to use the app and allowed participants to take a practice survey. The compensation structure was also explained at this time: Participants received \$45 for enrolling in the EMA study; \$10.00 for completing 50% of all EMA surveys; \$15.00 for completing 70% of all EMA surveys; and \$15.00 for completing 90% of all EMA surveys (totaling a maximum of \$85).

The 10-day EMA reporting period that followed always began on a Friday morning and ended on a Sunday night, which allowed for two weekends of data collection. During the EMA period, participants received prompts (similar to a text message notification) that alerted them when a new survey was available. These surveys were brief, taking only 1–2 minutes to complete. Participants received two surveys on weekdays, sent at random times during the interval between the end of school and 9:30pm; they received three surveys on weekend days, sent at random times during the interval between 10am and 9:30pm. The minimum amount of time between EMA prompts was 30 minutes. Surveys remained available for a 1-hour window. After completion of the EMA period, participants again met with interviewers to return their smartphone (if it was borrowed) and receive payment.

Measures

Baseline assessment asked adolescents about ever-use and past-30-day use of cigarettes, e-cigarettes, cigars/cigarillos, pipes, hookah, and SLT. Adolescents also reported age and race/ethnicity at baseline; parents reported education and household income at baseline (z-scored and averaged to create a measure of SES), as well as whether there were any adult tobacco users living in the home. Participants' county of residence was coded as either *urban* (residing in Franklin County, the county for Columbus, OH) or *rural* (residing in a county in Appalachian Ohio).

For the EMA surveys, participants answered questions about exposure to advertising since the last survey, including the product category (tobacco, alcohol, soda, snack food, or fast food), location (e.g., convenience store, the internet), type of product (e.g., cigarettes, SLT), and how much they enjoyed, liked, and found appealing the advertisement (e.g., *How enjoyable was the advertisement to you?*; 1=*not at all*, 9=*very*). These last three items served as our measure of attitude toward tobacco advertising.²¹ Participants who reported seeing more than one advertisement indicated their summary rating for all advertisements seen. Previous piloting work indicates that responding to these types of questions about advertising over a short-term period of 10 days does not change how much participants report noticing tobacco advertising.²² When participants reported not seeing any tobacco advertisements they received filler questions, to ensure equal survey lengths across circumstances. For example, participants who reported seeing advertising for alcohol or soda—but not tobacco—were asked about their attitudes towards those advertisements. Alternative filler items concerned topics such as diet and exercise.

EMA surveys also asked all participants: “Since the last time you completed this survey, have you used any of the tobacco products in the list below? Select all that apply.” This question provided a checklist of different tobacco products, and endorsement of any tobacco product was coded *tobacco use* (vs. *no use*). Once a day, participants were also asked “Do you think you’ll use any of the products below anytime soon? Select all that apply;” this question provided a checklist of substances and endorsement of any tobacco product was coded as a tobacco-use expectancy (vs. no tobacco-use expectancy).

Statistical Analysis

We first ran a series of calculations to determine the average value for several factors over the EMA period. These derived variables were used for the regression analyses described in the next paragraph (not for the multilevel models that follow). To determine *marketing exposure*, we summed, within participants, the number of instances over the EMA period where a tobacco advertisement was reported. This value was next divided by the total number of surveys completed by a participant, to obtain a value for the percentage of surveys where a tobacco advertisement was reported. For the *location of marketing exposures*, we examined instances of tobacco marketing exposure and summed, within participants, the number of times exposure was reported at each location. The count for each location was then divided by the total number of tobacco exposures reported by a participant, to obtain a value for the percentage of exposures happening at the point-of-sale, online, etc. For *attitudes toward tobacco advertisements*, each of the three tobacco attitude

items was averaged, within participants, over the EMA period. These three item averages were then aggregated, within participants, to form a single “average attitude” score. For *tobacco-use behavior*, we created a dichotomous variable that indicated whether a participant reported any tobacco use over the EMA period. Finally, for *tobacco-use expectancies*, we created a dichotomous variable that indicated whether a participant reported any expectancy for future tobacco use over the EMA period.

We next ran descriptive statistics to characterize the sample and examine EMA reporting. We then ran a series of regression analyses to determine whether marketing exposure predicted (1) attitudes toward the tobacco advertisements, (2) tobacco use behavior, and (3) tobacco-use expectancies. Analyses controlled for the additional family- and individual-level predictors described above: SES, adult tobacco user in the home, age, race/ethnicity (dichotomized as non-Hispanic White vs. All other races/ethnicities), urban/rural status, and past-30-day tobacco use. All of these analyses were conducted using SPSS version 24.

Next, because of the structure of the data, where surveys were nested within person, we tested the effects of marketing exposure using multilevel logistic regression, a type of multilevel model (MLM, also called a hierarchical linear model^{23,24}). MLMs allowed us to account for the variability within each person (Level 1) and between individuals (Level 2) across occasions. In this instance, we were primarily interested in Level 1 effects: adolescent responses in surveys where tobacco marketing exposure was reported versus responses in surveys where marketing was not reported. MLMs were run with random intercepts and compound symmetry covariance structure. We ran one model in which tobacco use was the dependent variable, and one model in which tobacco expectancies was the dependent variable (we could not run a model where attitudes was the dependent variable because adolescent attitudes were only assessed during instances of marketing exposure). For both models, tobacco marketing exposure was the Level 1 variable and the family- and individual-level predictors were the Level 2 variables. MLMs were estimated in Mplus version 7²⁵ using maximum likelihood estimation.

Results

Table 1 provides descriptive statistics for the final EMA sample. The average age for these adolescent males was 15 years (SD=1.2; range=11–16), 77% were non-Hispanic White, and 45% were from Appalachia. Forty percent of the sample had reported past-30-day tobacco use in a cohort survey. Participants completed an average of 76% of their assigned surveys (SD=13.0).

Marketing Exposures

On average, participants reported seeing a tobacco advertisement 1.9 times during the 10-day EMA period (10.6% of reports). Correlation and t-test analyses indicated that higher reports of tobacco marketing exposure was associated with lower family SES, having an adult tobacco users in the home, living in a rural area, and tobacco-use history; exposure was not related to age or race/ethnicity. Over 10% of participants reported seeing a tobacco advertisement 5 or more times over the EMA period (of these, 80% were tobacco users).

As shown in Figure 1, “convenience store or gas station” was by far the most common location where tobacco advertisements were reported (67.9%), followed by “grocery store, supermarket or pharmacy” (25.0%) and “on the internet” (23.2%). Thus, as expected, youth were most frequently viewing tobacco marketing at the retail points-of-sale. Cigarettes were the most commonly-reported type of tobacco advertised (40.1%), followed by SLT (32.2%), cigars (12.8%), and e-cigarettes (11.9%).

Consistent with our hypotheses, tobacco marketing exposure was greater among tobacco users compared to non-users (18.3% vs. 5.3% of reports, respectively, $t(89)=-4.41$, $p<.001$ when equal variance is not assumed). Likewise, tobacco marketing exposure was greater among rural compared to urban youth (14.1% vs. 7.7% of reports, respectively, $t(128.4)=-2.00$, $p=.047$ when equal variance is not assumed). Follow-up analyses on this latter finding suggest that the urban/rural difference was driven by one product: SLT advertisements were reported more by rural than urban youth [$t(103.4)=-2.78$, $p=.006$ when equal variance is not assumed].

Impact of Marketing Exposures

Overall, attitudes toward the tobacco advertisements were relatively low, with an average of 2.6 ($SD=2.1$) on a 1–9 scale (where higher scores indicate more favorable attitudes toward the advertisements). Yet as shown in Table 2, there was a significant association between the frequency of marketing exposure and attitudes, such that participants who reported more exposures to tobacco advertising had more favorable attitudes toward the advertisements they saw ($r=.47$, $p<.001$). This pattern was similar, although not statistically significant, for the relation between exposure to and attitudes regarding alcohol advertising ($r=.21$, $p=.057$) but did not appear for soda advertising ($r=-.07$, $p=.377$).

Regression analyses indicated that, controlling for the additional family- and individual-level predictors, marketing exposure was still associated with attitudes toward the tobacco advertisements ($\beta=.37$, $p=.001$; see Table 3). Past-30-day tobacco use was also a significant factor ($\beta=-.22$, $p=.044$), although urban/rural status was not. Marketing exposures were further associated with tobacco use ($OR=1.05$, 95% CI, 1.02–1.08, $p=.001$) and tobacco expectancies ($OR=1.05$, 95% CI, 1.02–1.08, $p=.002$)¹ in the logistic regressions; for both regressions, past-30-day tobacco use was a significant factor and urban/rural status was not. Exploratory analyses found that, for all regression outcomes (attitudes, use, and expectancies), the effect of marketing was not significantly moderated by past-30-day use. These regression findings are consistent with our hypothesis that greater exposure to tobacco marketing creates detrimental effects by increasing the favorability of attitudes toward tobacco marketing and increasing the likelihood of tobacco use and tobacco-use expectancies—over and above the confounding effects of prior tobacco use. We also had support for our hypothesis that tobacco users would report more positive attitudes to the tobacco advertisements and greater tobacco use and expectancies.

¹The ORs and 95% CIs for the effects of marketing were not perfectly identical for the tobacco use and tobacco expectancies logistic regressions, but happened to round to the same values.

Our first MLM indicated that, accounting for the additional family- and individual-level predictors, marketing exposure was significantly associated with tobacco use (OR=2.52, 95% CI, 1.06–6.01, $p=.037$). In other words, youth were more likely to report recent tobacco use in an EMA survey if they also reported recent tobacco marketing exposure (vs. no exposure) in that EMA survey. Similarly, our second MLM indicated that, again accounting for the additional family- and individual-level predictors, marketing exposure was significantly associated with tobacco expectancies (OR=6.47, 95% CI, 1.65–25.28, $p=.007$). Thus, youth were more likely to endorse an expectancy to use tobacco in the future during an EMA survey if they also reported recent tobacco marketing exposure (vs. no exposure) in that EMA survey. These findings further support our hypothesis that tobacco marketing exposure can increase adolescents' tobacco use and expectancies.²

Discussion

This study provides new insights into adolescent tobacco marketing exposures. Findings indicated that adolescents reported exposures to tobacco marketing an average of 1.9 times over a 10-day EMA period. They most frequently viewed tobacco marketing at retail points-of-sale, especially at convenience stores and gas stations. Further, we found that those youth who reported more exposures to tobacco marketing also had more favorable attitudes toward the tobacco advertisements they saw (a pattern that was not replicated in the case of alcohol and soda advertising); they also had a higher likelihood of tobacco use, and had higher tobacco-use expectancies for the future. These findings are consistent with previous literature arguing that exposure to cigarette and e-cigarette marketing increases susceptibility and use.^{5–15} Yet they extend that literature by demonstrating—through the aide of EMA—the detrimental effect of tobacco marketing in the real world, in close to real-time.

The present findings suggest that the magnitude and impact of tobacco marketing is not the same across all youth—rather, there are both differential exposures and differential vulnerabilities. Specifically, greater exposures occurred for the rural (compared to urban) participants and for the tobacco users (compared to non-users). Tobacco users also had higher positive attitudes, tobacco use, and tobacco expectancies. The finding that there was greater marketing exposure among the rural youth is concerning because their area—Appalachian Ohio—is a disadvantaged area marked by high adult tobacco-use prevalence.^{26,27} These rural adolescents are thus a vulnerable population whose risk for nicotine addiction is further heightened by tobacco marketing. The finding of greater exposure among tobacco users is likewise concerning because of evidence that tobacco marketing encourages progression along the tobacco uptake trajectory—from never smoking, to experimentation and occasional use, to regular smoking.^{28–31} Thus, although the fact that past-30-day users reported more use during the EMA period is not surprising, their more positive attitudes toward tobacco advertising and higher expectancies to use tobacco in the future demonstrate a risk for progression toward regular use.

²To further test the directional effect, we ran additional MLMs that accounted for past reports of use and expectancies. When our MLM on use added use-at-the-last-survey as an additional level-1 variable, the effect of marketing exposure on use dropped to non-significance in this model, in part due to greater variation in the confidence interval (OR = 2.17, 95% CI, 0.81–5.83, $p = 0.126$). However, when our MLM on expectancies added expectancy-at-the-last-survey as an additional level-1 variable, marketing exposure's effect was significant and grew in strength (OR = 7.32, 95% CI, 2.07–26.31 $p = .002$).

Findings also provide comprehensive information on all tobacco products to which youth are exposed, including cigarettes, SLT, and e-cigarettes. Capturing this information is important because the last decade has seen many changes in the variety and popularity of tobacco products, as well as changes in tobacco regulation. Most recently, the 2016 “deeming rule” extended the FDA regulatory authority beyond cigarettes and SLT to all other tobacco products, including e-cigarettes and cigars.³² It is critical that the FDA fully implement this deeming rule and build upon it by imposing restrictions that match those already applied to cigarettes and SLT. Currently, e-cigarette marketing, which has many features appealing to adolescents,³³ has very minimal marketing restrictions, including no restrictions on television advertising.¹⁵ Yet due to limitations of FDA authority, more local-level approaches may be necessary to address point-of-sale marketing. Licensing and zoning laws appear particularly promising, not only because they have the potential to reduce or restrict the number, density, location, or type of tobacco retailers^{34,35} but because they are considered legally sound³⁶ and avoid the First Amendment issues that arise from attempting to directly restrict advertising.³⁷

Limitations

This study was designed to examine attitudes toward the specific advertisements to which a youth was exposed; as we did not assess attitudes during periods of non-exposure, we were unable to examine how attitudes changed as a function of exposure. Similarly, this study was designed to examine self-reported exposures to tobacco advertising—it was not designed to determine why certain youth were reporting more exposure. Nevertheless, we suspect that greater reports of exposure were due to both the heightened awareness of certain youth to tobacco advertising (i.e., attentional bias), as well as marketing that specifically targets tobacco users. All participants in this study were aged 16 or younger, and thus well below the legal purchasing age for tobacco; as most underage youth obtain tobacco products from friends,^{38–40} we believe it is unlikely that marketing exposures were occurring during tobacco purchases. Sample size and low prevalences for the use of certain products prevented us from breaking-down the data to look at how use of specific products relates to attitudes or use regarding those products, but this has been examined well elsewhere with cross-sectional data.⁴¹

Conclusions

Overall, these EMA findings suggest that adolescents were exposed to a non-trivial amount of tobacco marketing on a weekly basis, and that greater exposure was associated with higher tobacco-related attitudes, use, and expectancies. These results underscore the importance of federal, state, and local-level tobacco regulatory policies to protect youth from the marketing that puts them at risk for a lifetime of nicotine addiction and tobacco-related diseases. Future research integrating EMA with prospective data could further elucidate how EMA-measured responses predict long-term outcomes such as regular tobacco use, as well as what risk and protective factors could be targeted to counteract the impact of tobacco marketing.

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Figure 1.

Average prevalence for where exposures to tobacco advertising occurred. Note: Participants could report more than one exposure location during a survey. *A follow-up question asking participants to describe the “other” location produced a variety of written-in responses, including “home” “idk” “school” and “surf shop.”

Table 1.

Descriptive statistics for male youth in the EMA study (n = 176), enrolled in Ohio from 2016–2017.

Characteristic	M(SD) or %
Parent with Bachelor's Degree	52.9%
Tobacco User in the Home	29.2%
Age	15.0 (1.2)
Race/Ethnicity	
White	77.3%
African American	8.0%
Hispanic	5.7%
Multiracial	5.7%
Other race	1.1%
Not reported	2.3%
Geographic Location	
Urban	55.1%
Rural	44.9%
Prior Past-30-Day Tobacco Use	40.3%

Table 2.

Exposures and attitudes for tobacco, alcohol, and soda advertisements over the 10-day EMA period.

Product Type	% (N) of Sample Who Reported Ad Exposure for the Product	Average % of Times Reported	Average Attitude Toward the Ad (SD) *	Correlation Between Exposure and Average Attitude (Pearson's <i>r</i>)
Tobacco	51.1% (90)	10.6%	2.6 (2.07)	.47 ***
Alcohol	49.4% (87)	7.8%	3.8 (1.66)	.21
Soda	83.5% (147)	17.0%	5.0 (1.56)	-.07

* Attitude was assessed on a 1–9 scale, where 1=*not at all* and 9=*very*.

 $p < .001$

Table 3.

Outcomes for adjusted linear and logistic regression models where marketing exposure predicted (1) Attitudes toward tobacco advertising, (2) Tobacco-use expectancies, and (3) Tobacco use during the EMA period.

	Attitudes N = 84	Tobacco Expectancies N = 165	Tobacco Use N = 165
	β	OR (95% CI)	OR (95% CI)
Family Characteristics			
SES	.10	1.05 (0.51, 2.16)	1.16 (0.58, 2.31)
Adult Tobacco User in Home ^a	-.14	0.83 (0.23, 2.97)	0.88 (0.26, 2.94)
Youth Characteristics			
Age	.10	1.12 (0.68, 1.16)	1.33 (0.82, 2.18)
Race/ethnicity ^b	-.09	0.47 (0.11, 2.03)	0.79 (0.22, 2.85)
Urban/Rural ^c	.11	1.20 (0.37, 3.90)	1.12 (0.37, 3.37)
Prior Past-30-Day Use ^d	-.22 [*]	0.03 (0.01, 0.17) ^{***}	0.06 (0.02, 0.20) ^{***}
Marketing Exposure	.37 ^{**}	1.05 (1.02, 1.08) ^{**}	1.05 (1.02, 1.08) ^{**}

Note: Participants were excluded from the attitudes analysis if over the 10-day EMA period they did not report any exposure to tobacco advertising (and thus could not be asked about their attitudes toward those advertisements), or if they had missing data for one or more of the covariates. Participants were excluded from the tobacco use and tobacco expectancies analyses if they had missing data for one or more of the covariates.

^{*}
p < .05,

^{**}
p < .01,

^{***}
p < .001.

^aFor logistic regressions, no adult user in home is the referent group.

^bFor logistic regressions, non-Hispanic White is the referent group.

^cFor logistic regressions, urban is the referent group.

^dFor logistic regressions, use is the referent group. SES = socioeconomic status.