Original investigation

Recall of Point-of-Sale Marketing Predicts Cigar and E-Cigarette Use Among Texas Youth

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Abstract

Introduction: While research has documented associations between recall of point-of-sale (POS) tobacco marketing and youth tobacco use, much of the research is cross-sectional and focused on cigarettes. The present longitudinal study examined recall of tobacco marketing at the POS and multiple types of tobacco use 6 months later.

Methods: The Texas Adolescent Tobacco Advertising and Marketing Surveillance System (TATAMS) is a large-scale, representative study of 6th, 8th, and 10th graders in 79 middle and high schools in five counties in Texas. Weighted logistic regression examined associations between recall of tobacco advertisements and products on display at baseline and ever use, current use, and susceptibility to use for cigarette, e-cigarette, cigar, and smokeless products 6 months later.

Results: Students' recall of signs marketing e-cigarettes at baseline predicted ever e-cigarette use and increased susceptibility to use e-cigarettes at follow-up, across all store types. Recall of e-cigarette displays only predicted susceptibility to use e-cigarettes at follow-up, across all store types. Both recall of signs marketing cigars and cigar product displays predicted current and ever cigar smoking and increased susceptibility to smoking cigars at follow-up, across all store types. Recall of cigarette and smokeless product marketing and displays was not associated with tobacco use measures.

Conclusion: The POS environment continues to be an important influence on youth tobacco use. Restrictions on POS marketing, particularly around schools, are warranted.

Implications: Cross-sectional studies have shown that exposure to POS cigarette marketing is associated with use of cigarettes among youth, though longitudinal evidence of the same is sparse and mixed. Cross-sectional studies have found that recall of cigars, smokeless product, and e-cigarette tobacco marketing at POS is associated with curiosity about tobacco use or intentions to use tobacco among youth, but limited longitudinal research has been conducted. Findings from the present longitudinal study suggest that recall of tobacco marketing at retail POS predicts ever use of e-cigarettes and cigars, current use of cigars, and susceptibility to cigar and e-cigarette use among youth.

Introduction

Historically, tobacco advertising in multiple channels has been shown to have an effect on adolescent tobacco use.¹ Since the 1998 Master Settlement Agreement banned tobacco advertising directed at youth,² tobacco companies have directed their efforts toward point-of-sale (POS) advertising in retail stores, a mostly unregulated marketing channel.³ POS advertising incorporates various marketing strategies, including but not limited to, tobacco product signs located in both the interior and exterior of the store as well as placement of tobacco product displays.⁴ In 2014, the tobacco industry spent \$238.2 million on POS advertising and promotions for cigarettes alone, an increase from the \$55.7 million spent in 2013.⁵ Smokeless tobacco advertising at the POS also increased from \$32.3 million in 2013 to \$33.0 million in 2014.⁶ A 2014 study of over 92000 tobacco retailers in the United States determined that 96% of these stores used at least one POS marketing tool.⁷ A national sample of 2230 outlets in the United States in 2012 found that 51.5% of tobacco outlets had any exterior marketing, 95.1% had interior marketing, and 75.1% had any form of price promotion.⁸ In a study of 129 tobacco retailers in an urban Ohio county, 95% had cigarette, 57% cigar, and 57% smokeless POS advertisements.³ E-cigarette POS advertisements were found in 32% of 213 retail outlets in New Jersey in 2014.⁹ Determining the relationship between POS advertising and youth tobacco use behaviors is important in understanding why young people use tobacco products and in support of regulation of all tobacco product marketing.

Most of the previous studies on the impact of POS advertising on youth focus on cigarettes. Through the review of several cross-sectional and longitudinal studies on youth, the 2012 Surgeon General's Report determined that receptivity to cigarette advertisements, measured by receiving, owning, or being willing to utilize a promotional item and having a favorite advertisement, were associated with smoking as well as susceptibility to future smoking.¹ Further research has focused on youth recall of cigarette POS advertising. Two systematic reviews, with a total of 12 cross-sectional studies, determined that POS marketing was significantly associated with youth smoking and susceptibility to smoking.^{10,11} However, there is limited longitudinal research on youth, and the results from these studies are mixed. One longitudinal study determined that exposure to cigarette POS advertising, as well as smoking by characters on TV, was associated with increased susceptibility to future smoking after a 2-year follow-up, yet this study did not examine POS advertising independently of TV.¹² Henriksen et al.¹³ determined that youth who saw tobacco advertisements in retail stores most frequently had higher odds of ever smoking 30 months later in comparison with youth who saw these advertisements least frequently, although no association was found at 12 months using a measure of self-reported recall. A study in the United Kingdom with a sample of 11–16 year olds found non-susceptible never smokers who self-reported exposure to more tobacco POS displays had greater odds of becoming susceptible to smoking 1 year later.¹⁴ One recent longitudinal study found that self-reported recall of exposure to e-cigarette advertisements at the retail setting predicted ever and current use of e-cigarettes as well as susceptibility to e-cigarette use 6 months later.¹⁵ More longitudinal research on recall of POS advertising is necessary, given the few studies to date.

Few studies focused on adolescents have observed the recall of other tobacco types of product POS advertising, including that for e-cigarettes, cigars, and smokeless tobacco. Data from the 2012 National Youth Tobacco Survey (NYTS) determined that recall

of tobacco POS advertising in retail stores, including convenience stores, grocery stores, and gas stations, was associated with increased curiosity about cigars (OR 1.54, 95% confidence interval (CI): 1.31, 1.80) and smokeless tobacco (OR 1.33, 95% CI: 1.13–1.58).¹⁶ One study determined that recalling e-cigarette displays in small shops was associated with ever use of e-cigarettes as well as intentions to use e-cigarettes in the future among never users.¹⁷ Mantey et al.,¹⁸ using data from the 2014 NYTS, also found that exposure to e-cigarette marketing, with retail exposure as one component of the measure, was associated with ever and current e-cigarette use as well as susceptibility to use e-cigarettes among non-users. Curiosity and intentions to use are two components used in measuring susceptibility, a valid measure in determining future use of cigarettes.^{19–22} Notably, all of these studies were cross-sectional, which limits the ability to make causal inferences. POS advertising may, in part, be currently unregulated due to a lack of longitudinal data on the effect of POS for all tobacco products.

The current study expands on the limited longitudinal research on the effects of tobacco product POS advertising on youth tobacco use.^{12,13,15} Moreover, we used longitudinal data to examine exposure to cigarette, e-cigarette, cigar, and smokeless tobacco POS advertising and the impact of exposure on use behaviors 6 months after initial assessment. The inclusion of all other tobacco products, beyond just cigarettes, is important for a better understanding of how POS marketing may influence youth tobacco use behaviors. Best et al.¹⁷ stated that assumptions cannot be made when examining how exposure to POS for other tobacco products may be similar to the effects seen from cigarette POS exposure, since cigarette marketing may be more widely well-known and recognized. Thus, our study can help to determine if POS advertising is consistent across other tobacco products.

For this study, data are used from the Texas Adolescent Tobacco Advertising and Marketing Surveillance System (TATAMS), a large-scale, representative study of youth enrolled in middle and high schools in the major metropolitan areas of the state. A focus on Texas will help to inform future policy development and regulatory action specific to tobacco control, as Texas ranks first in tobacco industry expenditures on marketing.²¹ The purpose of this study was to determine if recall of cigarette, e-cigarette, cigar, and smokeless tobacco marketing signs, as well as tobacco displays, at POS are related to youth ever and current use as well as susceptibility to future use. We hypothesized that exposure to POS advertising via both signs marketing the products and displays in stores would be associated with increased ever use, current use, and susceptibility to use these products, for all tobacco products.

Methods

Study Design

TATAMS is a rapid response surveillance system that follows students who were in the 6th, 8th, and 10th grades in 79 middle and high schools at baseline in five counties surrounding the four most populated cities in Texas (Houston, Dallas/Ft. Worth, San Antonio, Austin). More information on the study's sampling scheme and design are described elsewhere.²³ Baseline and follow-up data for this manuscript were collected from the same cohort of students in 2014–2015, approximately 6 months apart. At baseline, tablet-based surveys were administered in the classroom; at follow-up, web-based surveys were implemented outside of the classroom. Both surveys relied on the same electronic format, which included pictures

of tobacco products to enhance validity of related measures.²⁴ All survey measures were adapted from established and rigorous surveillance studies (e.g., Population Assessment of Tobacco and Health [PATH],²⁵ NYTS²⁶) and underwent cognitive testing before implementation.

Participants

A total of 3907 students (representing a population of $N = 461\,069$) completed the baseline survey (response rate = 36.9%), while 2483 ($N = 280\,450$) in this cohort took the follow-up survey 6 months later (weighted retention rate = 60.8%). At baseline, 49% of participants were female, while 54.5% of the students were Hispanic, 27.9% were non-Hispanic White/Other, and 17.6% non-Hispanic Black, representing the distribution of the students in the sampling frame. Students were evenly distributed across all grades.

Measures

Parallel measures of key outcomes (ever use, current use, and susceptibility) were assessed across categories of products (cigarettes, e-cigarettes, smokeless tobacco, and cigar products (little filtered cigars, cigarillos, large cigars)). Example items are given for cigarettes below.

Ever Use

All students at baseline and users at 6-month follow-up were asked “Have you EVER used cigarettes, even one or two puffs?” Those students who responded “Yes” were considered ever users and those who responded “No” were considered never users.

Current Use

Students who reported ever product use at either wave were asked “During the past 30 days, on how many days did you use cigarettes? Please enter the number of days (from 0 to 30 days).” Students who responded with 1 or more days were considered current (i.e., past 30 days) users.

Susceptibility to Use

Only students who reported never product use at either wave were asked the following three questions, which were based on established susceptibility measures.^{19,21,27–29} The first question asked “Have you ever been curious about using [tobacco product]?” with responses including “Not at all curious”, “A little curious”, “Somewhat curious”, and “Very Curious”. The other two questions included “Do you think you will use any of the following products in the next 12 months?” and “If one of your close friends were to offer you one of the following products, would you use it?” in reference to each product, separately. The responses for both of these questions were “Definitely not”, “Probably not”, “Probably yes”, and “Definitely yes.” If a student answered “Not at all curious” to the first question and “Definitely not” to the other two questions, they were considered non-susceptible. If students selected any other answer than “Not at all curious” or “Definitely not” to these three questions, they were considered susceptible.

Recall of Tobacco Advertising and Product Displays

To begin, students were asked, “During the past 30 days, how often have you visited [store type] near your school?” Store types included convenience stores/gas stations, drug stores (e.g., Walgreens), and grocery stores. Response options included “Never,” “Once a month,” “Two or three times a month,” “Once a week,” “Two

or three times a week,” and “Almost every day.” Responses were collapsed to indicate no exposure (“Never”) versus any exposure (all other response items). Recall of tobacco advertising at POS followed and was derived from the item, “When you visited [this store type], how often did you see signs marketing [tobacco product]?” Response options included “Never/Not that I remember,” “Some of the time you were in the store,” “Most of the time you were in a store,” and “Every time you were in a store.” Responses were collapsed to indicate no exposure (“Never/Not that I remember”) or any exposure (all other response items). Regression models were run using exposure as a categorical variable (i.e., comparisons between each level of exposure and non-exposure), and results suggested no significant differences between the levels of exposure. As such, for parsimony, models are presented with the dichotomous exposure variable only. Finally, recall of tobacco product displays was derived from the item “When you visited [store type], how often did you see [tobacco product] on display?” Response options were the same as the question on tobacco advertising, so they were also collapsed to indicate no exposure (“Never/Not that I remember”) or any exposure (all other response items). All measures were adapted from prior research.^{13,30} Analyses were also run to determine the correlation of the two exposure measures (i.e., signs and product displays) for each product.

Covariates

Demographic characteristics included the following: sex (female or male); race/ethnicity (Hispanic, Non-Hispanic White/Other, Non-Hispanic Black, given the way sampling weights were generated);²³ grade (6th, 8th, 10th); and socioeconomic status (SES). The latter was measured as “In terms of income, what best describes your family’s standard of living in the home where you live most of the time? Would you say your family is very well off, living comfortably, just getting by, nearly poor, or poor?” The first two options were collapsed to indicate higher SES and the last two options were collapsed to indicate lower SES, while the middle option indicated middle SES. Other tobacco use was measured as any past 30-day use of all other tobacco products than what was the primary outcome measure in each regression model.

Data Analysis

Simple descriptive statistics (proportions, 95% CIs) were used to calculate the percent of students who used or were susceptible to using tobacco products (Table 1) and the percent who recalled tobacco advertising and tobacco product displays at retail outlets surrounding their school at baseline (Table 2). Separate logistic regression models were fit for each exposure variable (i.e., recall of advertising, recall of product displays) and each outcome (i.e., ever use, current use, susceptibility to use), for each product (i.e., cigarettes, e-cigarettes, cigar products, smokeless tobacco). Exposure and outcome variables were aligned, for each tobacco product (e.g., models assessed the relationship between exposure to signs that market cigarettes and cigarette use). All models adjusted for sex, grade level, race/ethnicity, SES, and current (i.e., past 30 days) use of any other tobacco product. Sampling weights were applied to generalize results to all 6th, 8th, and 10th grade students in the five counties surrounding the four most populated cities in Texas; to account for the cluster effect of students within schools; and to adjust for non-response bias at follow-up.²³ A listwise procedure was used in handling missing data. Analyses were performed using STATA 14.0 (College Station, TX).

Table 1. Cigarette, E-cigarette, Cigar, and Smokeless Tobacco Use and Susceptibility at Baseline and 6-month Follow-up; Texas Adolescent Tobacco Advertising and Marketing Surveillance System (TATAMS), 2014–2015 ($n = 3907$, $N = 461\ 069^a$)

	Baseline ($n = 3907$, $N = 461\ 069$)				Follow-up ($n = 2488$, $N = 461\ 069$)			
	n	N	% ^b	95% CI	n	N	% ^b	95% CI
Susceptibility								
Cigarettes	636	74 308	19.2	(16.4, 22.3)	328	62 334	15.8	(12.9, 19.2)
E-cigarettes	956	112 148	31.3	(27.9, 35.0)	516	87 346	24.2	(20.3, 28.7)
Cigar products	573	72 922	17.6	(14.8, 20.7)	259	49 413	11.8	(9.3, 14.8)
Smokeless tobacco	519	67 970	15.7	(13.4, 18.4)	252	47 553	10.8	(8.7, 13.4)
Ever use								
Cigarettes	340	50 065	10.9	(8.8, 13.4)	260	58 412	12.7	(10.0, 16.0)
E-cigarettes	688	90 070	19.5	(15.8, 23.9)	457	93 426	20.3	(16.3, 25.1)
Cigar products	201	27 807	6.0	(4.7, 7.7)	160	35 795	7.8	(5.8, 10.3)
Smokeless tobacco	95	8 689	1.9	(1.2, 2.9)	68	13 184	2.9	(1.8, 4.4)
Current use								
Cigarettes	89	16 025	3.5	(2.4, 5.0)	38	8 000	1.7	(1.1, 2.8)
E-cigarettes	261	34 091	7.4	(5.9, 9.3)	102	16 652	3.9	(2.6, 5.6)
Cigar products	68	8 812	1.9	(1.3, 2.9)	37	6 973	1.5	(0.9, 2.5)
Smokeless tobacco	35	3 281	0.7	(0.4, 1.4)	17	1 826	0.4	(0.2, 1.0)

^aStudent population in the five counties surrounding the four largest cities in Texas (Houston, Dallas/Ft. Worth, San Antonio, Austin) to which the sample (n) generalizes.

^bWeighted percentage.

CI = confidence interval.

Table 2. Recall of Any Tobacco Advertising and Tobacco Product Displays at Retail Outlets Surrounding Schools at Baseline; Texas Adolescent Tobacco Advertising and Marketing Surveillance System (TATAMS), 2014–2015 ($n = 3907$, $N = 461\ 069^a$)

	Tobacco advertising ^b		Tobacco displays ^c	
	% ^c	95% CI	% ^c	95% CI
Convenience store ($n = 3491$, $N = 407\ 573^d$)				
Cigarettes	85.3	83.3, 87.2	92.7	90.9, 94.1
E-cigarettes	63.1	60.3, 65.7	66.0	62.6, 69.2
Cigar products	47.6	44.4, 50.8	53.8	50.5, 57.1
Smokeless tobacco	50.1	46.7, 53.6	52.4	48.5, 56.3
Drug store ($n = 2981$, $N = 341\ 620^d$)				
Cigarettes	88.2	86.4, 89.8	94.1	92.7, 95.2
E-cigarettes	65.2	62.1, 68.3	68.3	64.9, 71.5
Cigar products	48.7	45.3, 52.2	55.0	51.2, 58.7
Smokeless tobacco	51.5	47.8, 55.1	53.9	49.9, 57.9
Grocery store ($n = 3343$, $N = 386\ 083^d$)				
Cigarettes	85.2	83.3, 86.9	91.9	90.0, 93.5
E-cigarettes	61.8	58.8, 64.7	64.0	60.1, 67.8
Cigar products	47.2	43.8, 50.5	52.8	49.3, 56.2
Smokeless tobacco	49.8	46.5, 53.2	52.7	49.0, 56.3
Any store type ($n = 3692$, $N = 428\ 130^d$)				
Cigarettes	84.1	81.9, 86.0	91.4	89.4, 93.1
E-cigarettes	61.8	59.0, 64.6	64.4	60.9, 67.8
Cigar products	46.5	43.4, 49.6	52.3	49.0, 55.6
Smokeless tobacco	49.2	46.0, 52.4	51.6	47.8, 55.3

^aStudent population in the five counties surrounding the four largest cities in Texas (Houston, Dallas/Ft. Worth, San Antonio, Austin) to which the sample (n) generalizes.

^bDerived from item “When you visited [store type], how often did you see signs marketing [product]?”. Values assigned to response categories include (a) “never” = 0; (b) “some of the time,” “most of the time,” and “every time” = 1.

^cDerived from item “When you visited [store type], how often did you see [product] on display?”. Values assigned to response categories include (a) “never” = 0; (b) “some of the time,” “most of the time,” and “every time” = 1.

^dRespondents for each category were limited to those who reported they visited that type of store (e.g., convenience store).

^eWeighted percentage.

CI = confidence interval.

Table 3. Relationship Between Recall of Tobacco Advertising at Baseline^a and Tobacco Use Behaviors at 6-month Follow-up; Texas Adolescent Tobacco Advertising and Marketing Surveillance System (TATAMS), 2014–2015 (*n* = 3907, *N* = 461 069^b)

	Convenience store ^c (<i>n</i> = 2250; <i>N</i> = 414 839)		Drug store ^c (<i>n</i> = 1963; <i>N</i> = 353 156)		Grocery store ^c (<i>n</i> = 2178; <i>N</i> = 396 981)		Any store type ^c (<i>n</i> = 2385; <i>N</i> = 437 490)	
	AOR ^h	95% CI	AOR ^h	95% CI	AOR ^h	95% CI	AOR ^h	95% CI
Susceptibility ^d								
Cigarettes	1.3	0.73, 2.32	1.7	0.94, 3.08	1.79	0.87, 3.68	1.45	0.81, 2.59
E-cigarettes	2.28	1.59, 3.26	2.13	1.49, 3.05	2.28	1.63, 3.19	2.24	1.61, 3.12
Cigar products ^e	1.91	1.12, 3.23	2.1	1.32, 3.34	2.27	1.27, 4.04	2.07	1.27, 3.37
Smokeless tobacco	1.47	0.84, 2.56	1.62	0.91, 2.87	1.5	0.87, 2.58	1.5	0.88, 2.55
Ever use ^e								
Cigarettes	1.6	0.38, 6.76	0.9	0.21, 3.81	1.58	0.37, 6.78	1.91	0.47, 7.7
E-cigarettes	2.82	1.4, 5.66	3.31	1.36, 8.03	3.95	1.65, 9.46	2.71	1.36, 5.4
Cigar products ^e	5.19	2.18, 12.32	4.7	1.83, 12.02	5.9	2.33, 14.91	5.31	2.28, 12.38
Smokeless tobacco	2.0	0.55, 7.2	1.7	0.43, 6.82	4.08	0.9, 18.56	3.18	0.88, 11.48
Current use ^f								
Cigarettes	0.57	0.17, 1.95	0.78	0.16, 3.7	0.32	0.09, 1.11	0.61	0.19, 1.96
E-cigarettes	1.88	0.99, 3.56	1.81	0.8, 4.1	1.85	0.89, 3.85	2.02	1.07, 3.83
Cigar products ^e	9.97	2.55, 39	6.94	1.68, 28.59	8.8	2.14, 36.11	10.57	2.68, 41.66
Smokeless tobacco	4.11	0.56, 30.22	4.71	0.5, 44.52	3.06	0.32, 29.51	4.69	0.6, 36.96

Values in italics represent statistically significant associations.

^aDefined as self-reported exposure to tobacco advertising (never/anytime) at (store type). Question: When you visited (this store type), how often did you see signs marketing (tobacco product).

^bStudent population in the five counties surrounding the four largest cities in Texas (Houston, Dallas/Ft. Worth, San Antonio, Austin) to which the sample (*n*) generalizes.

^cRespondents for each category were limited to those who reported they visited that type of store (e.g., convenience store).

^dDefined as a lack of a firm commitment not to use the (product).

^eDefined as ever use of (product), even one or two puffs.

^fDefined as use of (product) at least once in the last 30 days.

^gDefined as large cigars, cigarillos, and/or little filtered cigars (i.e., all questions combined).

^hWeighted logistic regression model, adjusted for sex, grade level, race/ethnicity, SES, current other tobacco product use.

AOR = Adjusted Odds Ratio; CI = confidence interval.

Results

Use of all types of tobacco products is provided in Table 1, for baseline and the 6-month follow-up. At baseline, almost all students reported visiting a retail store close to their school at least one time in the last month: 89.1% of students reported visiting a convenience store or gas station, 84.6% reported visiting a grocery store, and 75.0% visited a drug store. The median number of store visits per week across store types was 3.75. Among those students who visited stores, at least half reported seeing signs marketing specific tobacco products (Table 2). Recall of signs marketing cigarettes and cigarette product displays predominated, with more than 80% and 90% of students, respectively, saying they saw these across all store types. Recall specific to e-cigarettes followed, with over 60% of students reporting seeing signs marketing e-cigarettes and e-cigarette displays in stores. Finally, recall of cigar and smokeless tobacco advertising and displays were equally common, with over 45% reporting seeing signs marketing these products and over 50% reporting they saw these products displayed in the stores. The two exposure measures, recall of signs marketing the product and recall of product displays, were highly correlated (cigarettes, $r = 0.52$; cigars, $r = 0.62$; smokeless, $r = 0.63$; e-cigarettes, $r = 0.66$).

Table 3 presents the results of analyses that examine recall of signs marketing tobacco products at baseline and tobacco product use at 6-month follow-up, after adjusting for covariates. Students' recall of

signs marketing e-cigarettes at baseline predicted ever e-cigarette use (Adjusted Odds Ratio [AOR] = 2.71–3.95; $p < 0.05$) and increased susceptibility to use e-cigarettes (AOR = 2.13–2.28; $p < 0.05$) at 6-month follow-up, after adjusting for all covariates, across all store types and the combined measure. Similarly, students' recall of signs marketing cigars at baseline predicted ever cigar smoking (AOR = 4.7–5.9; $p < 0.05$) and increased susceptibility to smoking cigars (AOR = 1.91–2.27; $p < 0.05$) at 6-month follow-up, across all store types and the combined measure. Also, students' recall of signs marketing cigars predicted current cigar use (AOR = 6.94–10.57; $p < 0.05$) at the 6-month follow-up, across all store types and the combined measure, but only predicted current e-cigarette use for the measure of all store types combined (AOR = 2.02, 95% CI: 1.07, 3.83).

Table 4 presents the results of analyses that examine recall of in-store tobacco product displays at baseline and tobacco product use at 6-month follow-up. Students' recall of cigar product displays at baseline consistently predicted ever cigar product use (AOR = 10.84–11.86; $p < 0.05$), current cigar product use (AOR = 4.35–7.34; $p < 0.05$), and susceptibility to cigar product use (AOR = 1.76–1.82; $p < 0.05$) at 6-month follow-up, after adjusting for covariates, across all store types and the combined measure. Students' recall of e-cigarette displays at baseline only predicted susceptibility to use e-cigarettes (AOR = 2.05–2.37; $p < 0.05$) at the 6-month follow-up, across all store types and the combined measure.

Table 4. Relationship Between Recall of Tobacco Product Displays at Baseline^a and Tobacco Use Behaviors at 6-month Follow-up; Texas Adolescent Tobacco Advertising and Marketing Surveillance System (TATAMS), 2014–2015 (*n* = 3907, *N* = 461 069^b)

	Convenience store ^c (<i>n</i> = 2250; <i>N</i> = 414 839)		Drug store ^c (<i>n</i> = 1963; <i>N</i> = 353 156)		Grocery store ^c (<i>n</i> = 2178; <i>N</i> = 396 981)		Any store type ^c (<i>n</i> = 2385; <i>N</i> = 437 490)	
	AOR ^h	95% CI	AOR ^h	95% CI	AOR ^h	95% CI	AOR ^h	95% CI
Susceptibility ^d								
Cigarettes	1.33	0.47, 3.73	1.57	0.63, 3.96	1.33	0.47, 3.75	1.56	0.58, 4.18
E-cigarettes	2.05	1.46, 2.89	2.37	1.68, 3.34	2.22	1.59, 3.09	2.08	1.5, 2.89
Cigar products ^e	1.83	1.13, 2.96	1.8	1.2, 2.71	1.76	1.09, 2.85	1.82	1.17, 2.85
Smokeless tobacco	1.36	0.8, 2.29	1.66	1, 2.75	1.33	0.82, 2.15	1.42	0.86, 2.37
Ever use ^e								
Cigarettes	0.39	0.13, 1.12	0.21	0.06, 0.75	0.43	0.15, 1.26	0.52	0.18, 1.46
E-cigarettes	0.84	0.42, 1.68	0.76	0.33, 1.76	0.99	0.43, 2.29	0.95	0.49, 1.87
Cigar products ^e	10.84	3.6, 32.64	11.86	3.01, 46.74	11.17	3.45, 36.23	11.34	3.82, 33.61
Smokeless tobacco	3.1	0.8, 12.09	2.52	0.57, 11.07	3.4	0.75, 15.46	4.44	1.15, 17.12
Current use ^f								
Cigarettes	1.22	0.34, 4.46	2.05	0.2, 20.62	0.48	0.13, 1.74	1.27	0.36, 4.55
E-cigarettes	1.25	0.58, 2.73	1.83	0.71, 4.7	1.21	0.52, 2.83	1.39	0.66, 2.93
Cigar products ^e	6.88	2.03, 23.27	4.35	1.2, 15.68	5.85	1.65, 20.75	7.34	2.15, 24.99
Smokeless tobacco	4.2	0.44, 40.53	3.32	0.37, 29.71	2.55	0.26, 24.63	4.51	0.48, 42.23

Values in italics represent statistically significant associations.

^aDefined as self-reported exposure to tobacco product displays (never/anytime) at (store type). Question: When you visited (store type), how often did you see (tobacco product) on display?

^bStudent population in the five counties surrounding the four largest cities in Texas (Houston, Dallas/Ft. Worth, San Antonio, Austin) to which the sample (*n*) generalizes.

^cRespondents for each category were limited to those who reported they visited that type of store (e.g., convenience store).

^dDefined as a lack of a firm commitment not to use the (product).

^eDefined as ever use of (product), even one or two puffs.

^fDefined as use of (product) at least once in the last 30 days.

^gDefined as large cigars, cigarillos, and/or little filtered cigars (i.e., all questions combined).

^hWeighted logistic regression model, adjusted for sex, grade level, race/ethnicity, SES, current other tobacco product use.

CI = confidence interval.

Discussion

This study demonstrates an important association between recall of POS marketing of tobacco products and use or susceptibility to use certain tobacco products. In the fully adjusted model, recall of signs marketing cigars and e-cigarettes predicted ever use, current use, and susceptibility to use cigars, as well as ever use and susceptibility to use e-cigarettes, respectively. Similarly, recall of in-store cigar displays predicted ever use, current use, and susceptibility to use cigar products in the fully adjusted model. Recall of in-store display of e-cigarettes only predicted susceptibility to use e-cigarettes. Taken together, these results suggest a strong, positive relationship between advertising at POS and cigar and e-cigarette use behaviors among youth. Further, results were consistent across store types, indicating that limiting exposure to tobacco marketing in any store type, not just convenience stores, is important. Finally, recall of signs and products on display is highly correlated but not completely overlapping suggesting that both measures are important when examining the impact of marketing on tobacco use behaviors.

Interestingly, there was no demonstrable association between POS marketing for cigarettes and use of/susceptibility to use cigarettes, contrary to findings in earlier literature.^{1,10,11,14,30,31} It is worth noting, however, that few of these prior studies specific to cigarette smoking have been prospective. Evidence from longitudinal research to date has been mixed, with some studies observing a positive association between frequency of observing signs marketing cigarettes

(i.e., recall of tobacco advertising) and youth ever cigarette smoking (Henrickson et al., 2010)¹³ and susceptibility among non-susceptible never users,¹⁴ while others have showed statistically insignificant results (Dauphinee et al., 2013).³² Our findings are consistent with the latter. In Henriksen's prospective study, a statistically significant association was absent at 12 months for self-reported recall of exposure, but present at 30-month follow-up, suggesting that duration of follow-up may impact the outcome. Thus, our 6-month follow-up period may have contributed to the absence of a statistically significant association between recall of exposure to POS tobacco marketing at baseline and subsequent cigarette use behavior. Future studies should seek to establish if (and possibly why) the duration from baseline to follow-up might contribute to this difference in statistical significance. A difference in exposure measure might also be responsible for the difference in findings in prospective studies assessing this association. For example, in contrast to our study that used recall of exposure to POS marketing as exposure, Dauphinee's study used cigarette brand recognition at baseline as a measure of exposure. Bogdanovica et al. assessed this relationship among non-susceptible never users, which may account for differences in findings.¹⁴ More longitudinal studies are needed to determine the true nature of the relationship between POS cigarette advertising and cigarette use behaviors among youth.

Importantly, this study establishes a reference for future studies on associations between POS advertising and cigar and e-cigarette

use and susceptibility for use, as well as for policies regulating tobacco products, as it demonstrates that the positive association that may exist between POS marketing and tobacco product use/susceptibility for use is not limited to cigarettes alone. The study provides timely and much needed evidence given the paucity of studies exploring the associations between POS marketing and less conventional combustible tobacco products like cigars and emerging products like e-cigarettes. Though all cross-sectional, the studies investigating these relationships had similar results to those in our study.^{16–18,33} They demonstrated a higher curiosity about cigars,¹⁶ and higher use of/susceptibility to use e-cigarettes,^{15,17,18,33} among youth exposed to POS marketing of cigars and e-cigarettes, respectively. Similar to our study, exposure in these three studies was assessed based on participants' recall of POS displays¹⁶ or POS advertisements or promotions for tobacco products.^{17,18,33,34} This growing body of evidence highlighting these important associations is further strengthened by the longitudinal nature of our study, underscoring that these findings should not be ignored.

Findings from this study and others³⁵ suggest a majority of youth frequent retail tobacco outlets at least once a week, if not more often. Further, the evidence also suggests the need for policies regulating tobacco product and e-cigarette marketing at POS. Specific regulations would include reducing the density of retail tobacco outlets, particularly, around schools,³⁶ policies promoting tobacco-free pharmacies, removing the powerwall³⁷ or tobacco product displays,³⁸ banning or limiting the number of signs marketing tobacco products inside and outside convenience stores in close proximity to schools, separating tobacco products in stores from stands frequently visited by youth (like candy stands), and limiting the sale of flavored products around schools or to certain types of tobacco outlets such as tobacco/smoke shops. Such policies would reduce the interaction of youth with tobacco marketing, which specifically targets youth and to which youth seem particularly susceptible.^{1,39,40} These regulations are likely to be met with major opposition from tobacco industries, and given the current limitations on the ability to create federal regulations related to tobacco product sales, marketing and use, greater impact is likely to be made at state and local government levels. Unlike cigarette advertising, there are currently no federal statutes limiting the regulation of non-cigarette tobacco product advertising by local and state governments,⁴¹ a point which further emphasizes the potential effectiveness of policy making at state and local government levels.

Our study is not without limitations. Advertising of tobacco products at the POS is arguably more likely to be noticed—and hence reported—by individuals who are already familiar with these products; thus, these results might be an over-representation of the true impact of POS advertising on adolescents. Future studies are needed which explore these associations among non-users of tobacco at baseline to determine how tobacco marketing may impact their future tobacco use. Also, worth noting is the self-reported nature of the data and its potential for bias. Future research should include directly observed measures of marketing at the POS and link these observations to tobacco use behaviors. While some studies have begun using virtual reality to determine how regulation of the POS (e.g., hiding of the advertising “power wall”) may alter the influence of tobacco marketing on youth behaviors and susceptibility^{37,38}, continued research is needed which documents the physical POS environment, particularly given the changing landscape of tobacco products and recent changes in regulation. Furthermore, the results and trends described here among Texas adolescents may not be generalizable to regions with significant differences in demographic and/or political

makeup; the school-based nature of the study means results may not be generalizable to out-of-school-youth. Additionally, the low prevalence of use of several products, particularly for current use, may have limited our ability to detect associations. Finally, we did not assess the impact of cross-product associations (e.g., impact of exposure to e-cigarette marketing on cigarette use). In a recent study with 11–16 year olds, exposure to e-cigarette advertising was associated with lower perceived harm of smoking one to two cigarettes per day occasionally as compared with the control group.⁴² Additional, future work is needed which continues to examine how marketing of one product may impact other tobacco product use. Despite these limitations, the findings are robust, and this study serves as a much needed addition to the growing body of published research on the impact of POS marketing of tobacco products and e-cigarettes on product use among adolescents. As a longitudinal study, it provides important foundational data in establishing causality. This, in addition to its large weighted sample size, greatly increases the external validity of the study and reinforces the conclusions.

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Declaration Of Interests

None declared.

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