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Original investigation

# Marketing Exposure Recall is Associated With Past 30-Day Single, Dual, Polytabacco Use Among US Adolescents

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## Abstract

**Introduction:** This study assesses the relationship between tobacco/e-cigarette marketing exposure and single, dual, and polytabacco product use, among adolescents. Given the increased use of noncigarette tobacco products (eg, cigars, e-cigarettes, hookah) among youth, it is imperative to understand if marketing exposure is associated with dual and polytabacco product use.

**Methods:** Data were obtained from the 2014 National Youth Tobacco Survey and weighted to be representative of US middle and high school students. Multivariable multinomial logistic regression models were used to assess the relationships between product marketing (via internet, print, retail, and TV/movies) and past 30-day single, dual, and poly (three or more) tobacco product use. Three analyses were conducted using different categories as referent groups to allow for comprehensive examination of the relationships between all groups.

**Results:** Marketing exposure was significantly correlated with a greater risk of single, dual, and polytabacco product use relative to nonusers. Relative to single product users, product marketing exposure was significantly correlated with a greater relative risk of dual and polytabacco use. There was no statistical difference in the association of marketing exposure between dual and polytabacco use, in any model.

**Conclusion:** A positive relationship between tobacco product marketing exposure and number of tobacco products used was observed. The magnitude of the relationship grew from single product to dual/poly use. Restrictions of marketing of all tobacco products, similar to cigarettes, particularly in the retail setting, should be considered.

**Implications:** This study has two primary public health implications. First, self-reported exposure to tobacco/e-cigarette marketing is widespread among adolescents of all tobacco product categories. Second, this widespread exposure to tobacco/e-cigarette marketing appears to not only be correlated with use of a single tobacco product (eg, cigarettes, e-cigarettes), but also multiple tobacco products. While longitudinal studies are needed to further investigate the relationships observed in this study, findings justify further study given the known relationship between tobacco marketing exposure and subsequent cigarette use.

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## Introduction

Tobacco use remains a leading cause of preventable death among Americans and more than 480 000 US deaths each year are attributable to cigarette smoking.<sup>1</sup> Among youth, the prevalence of cigarette use has decreased since 1997, yet use of other tobacco products, including e-cigarettes, cigars/cigarillos, and hookah, has increased significantly.<sup>2</sup> The use of more than one tobacco product, also known as dual (use of two products) or poly (use of three or more products) use, among youth is concerning. The 2012 Surgeon General's Report on youth and young adult tobacco use reported more than 50% of high school male tobacco users, and nearly 35% of female tobacco users use more than one tobacco product in the past 30 days.<sup>3</sup>

More recent research has found the prevalence of dual and poly use has increased significantly among tobacco users,<sup>4</sup> and that dual and polytobacco use is the most common trend in adolescent tobacco use in the United States.<sup>5</sup> Similarly, among Texas youth, 77.2% of past 30-day e-cigarette users also reported using at least one other tobacco product in the past 30 days.<sup>6</sup> Dual and poly use has been correlated with other risk behaviors, including marijuana and alcohol use.<sup>7</sup> Further, while the literature is still developing, previous research has demonstrated clear differences between dual and polytobacco use by sociodemographic factors (eg, sex, race/ethnicity),<sup>8-10</sup> tobacco use profile (eg, nicotine dependence, age of initiation),<sup>8-10</sup> and psychosocial variables (eg, sensation seeking, self-efficacy, harm perception)<sup>8-11</sup> among youth and young adults.

The 2012 Surgeon General's Report suggested a causal link between cigarette marketing and cigarette use among youth.<sup>3</sup> In 2013, tobacco companies spent approximately \$9 billion on cigarette marketing, with the vast majority found in the retail setting with promotional activities such as price discounts and product placements/displays.<sup>12</sup> Promotions that reduce the price of cigarettes is of particular concern as adolescents are more sensitive to tobacco pricing than adults.<sup>13</sup> The relationship between marketing, price, and adolescent cigarette use is well documented.<sup>3</sup>

As e-cigarettes are a relatively new and evolving market, less is known about the effects of adolescent exposure to e-cigarette marketing. Exposure to e-cigarette marketing has increased dramatically since 2011; one study estimated 76% of all youth e-cigarette marketing exposure occurred on television through cable networks.<sup>14</sup> According to the 2014 National Youth Tobacco Survey (NYTS), 69% of adolescents reported seeing any e-cigarette advertisements and 36.5% of students reported ever seeing e-cigarette product promotion on television or in movies.<sup>15</sup> This is an important finding as these marketing strategies are prohibited for cigarettes. Multivariable models from previously published research using these NYTS data revealed e-cigarette marketing exposure was statistically associated with greater odds of ever (odds ratio: 1.16)<sup>16</sup> and past 30-day (odds ratio: 1.22)<sup>16</sup> use of e-cigarettes among adolescents.<sup>16,17</sup> Experimental studies of e-cigarette marketing and adolescent use behaviors have found similar results.<sup>18-20</sup>

Less is known about the relationship between tobacco marketing exposure and adolescent use of noncigarette tobacco products (eg, cigars, smokeless tobacco). These products have a substantial marketing presence within the channels observed in this study, including the use of print marketing in magazines, product placement in movies, and product promotions in retail settings.<sup>3</sup> Additionally, smokeless tobacco products are often marketed for concurrent use with cigarettes,<sup>21-25</sup> which highlights the need to examine the relationship between tobacco marketing exposure and dual/poly product use.

Most research examining tobacco marketing exposure has focused on the use of a particular tobacco product. However, less is known about how the tobacco marketing environment (ie, marketing of multiple tobacco products) influences dual and polytobacco use. Despite the growth in multiple tobacco product use among adolescents and young adults,<sup>26,27</sup> as well as tobacco marketing exposure,<sup>28-30</sup> there is limited research that addresses questions of exposure and dual and polytobacco use. As such, the purpose of this research is to examine the relationship between single, dual, and polytobacco product use and exposure to tobacco/e-cigarette marketing in a nationally representative sample of middle school and high school students. This is of interest to public health research given the growth in dual and polytobacco use,<sup>4,5</sup> the diversity of products available,<sup>2</sup> and the associations observed between tobacco marketing exposure and use of noncigarette tobacco products.<sup>16-25,31</sup>

## Study Aims and Hypotheses

This study has three hypotheses. First, we hypothesize exposure to tobacco e-cigarette marketing will be positively associated with single, dual, and polytobacco use, relative to nonusers. Second, we hypothesize exposure to tobacco e-cigarette marketing will be positively associated with dual and polytobacco use, relative to single product users. Third, we hypothesize exposure to tobacco e-cigarette marketing will be positively associated with polytobacco use, relative to dual use. To our knowledge, this study is the first to examine exposure to tobacco marketing and to examine the relationship between this marketing exposure and dual or polytobacco product use.

## Methods

### Study Sample and Population

This study analyzed data from the 2014 NYTS, a representative sample of middle school and high school students, in the United States. A stratified, three-stage cluster sample design is used to obtain the representative sample. The 2014 sample collected data from 207 schools, nationwide, with a sample size of 22 007.<sup>32</sup> However, 1322 respondents (6%) were excluded due to missing sociodemographic data (eg, sex, race/ethnicity, grade) for a final sample of 20 685. To conservatively approach tobacco use prevalence, missing responses for past 30-day tobacco use were recoded as nonuse.

### Procedure

NYTS sampling procedures are probabilistic and conducted without replacement at all stages. The first stage of sampling was to select primary sampling units within each stratum, then schools within each selected primary sampling unit, and lastly classes within each selected school. Participation by schools and students are voluntary and student responses remain anonymous. The procedure is described in detail elsewhere.<sup>32</sup>

## Measures

### Past 30-Day Tobacco Product Use

Past 30-day tobacco use was assessed for nine products: cigarettes, cigars/cigarillos/little cigars, smokeless tobacco, pipe, bidis, hookah, snus, dissolvable tobacco, and e-cigarettes. Use of each product was assessed individually through the following question: "During the past 30 days, on how many days did you [use product]?" Individuals that reported use of a product on 1 or more days in the past 30 days were considered "past 30-day users" of that particular product.

Those that reported no tobacco use in the past 30 days were considered “nonusers” (coded as 0); this group consists of never tobacco users and ever users that did not use in the past 30 days. Those that reported using only one of the nine tobacco products in the past 30 days were considered “single product users” (coded as 1). Those that reported using any two of the nine tobacco products in the past 30 days were considered “dual product users” (coded as 2). Those that reported use of three or more of the nine tobacco products in the past 30 days were considered “poly product users” (coded as 3).

Several products observed in this study have a small presence in US markets, with limited advertising via traditional marketing channels. However, direct and indirect marketing messages may still influence use of these tobacco products by youth. Directly, at least one channel of exposure assessed (eg, internet) could be a potential source for exposure to marketing of all these products. Indirectly, studies have shown the association between tobacco marketing exposure and tobacco-related normative beliefs<sup>33</sup> and product use<sup>31,34</sup> is not necessarily product specific. Therefore, exposure to cigarette-specific marketing may impact normative beliefs and use behaviors of not only cigarettes but of noncigarette products as well. Further, the traditional tobacco marketing questions used were not product specific. As such, all products were included in the assessment of total number of tobacco products used in the past 30 days.

#### Exposure to Tobacco Marketing

Self-reported exposure to tobacco (ie, cigarettes or other conventional tobacco) and e-cigarette marketing via four marketing channels served as the independent variable. E-cigarette and tobacco product marketing exposure were assessed independently of each other. This is an important distinction as there are substantive differences in e-cigarette marketing regulations, relative to conventional cigarettes and smokeless tobacco.<sup>35-38</sup>

Internet, print, and retail exposure questions for the two product categories had identical phrasing: “When you are using the Internet, how often do you see ads or promotions for [cigarettes or other tobacco products] / [electronic cigarettes or e-cigarettes]?” “When you read newspapers or magazines, how often do you see ads or promotions for [cigarettes or other tobacco products] / [electronic cigarettes or e-cigarettes]?” “When you go to a convenience store, supermarket, or gas station, how often do you see ads or promotions for [cigarettes or other tobacco products] / [electronic cigarettes or e-cigarettes]?” Due to differences in marketing regulations,<sup>35-38</sup> TV/Movie marketing exposure questions differed by product: “When you watch TV or go to the movies, how often do you see actors using cigarettes or other tobacco products?” and “When you watch TV or go to the movies, how often do you see ads or promotions for electronic cigarettes or e-cigarettes?”.

Possible responses for each of these questions were “never,” “rarely,” “sometimes,” “most of the time,” or “always,” and represented the intensity of exposure. These responses were coded continuously from 0 (never) to 4 (always). Total marketing exposure was computed as degree of marketing exposure reported for each product. Possible marketing exposure values ranged from 0 to 32 given that there were four sources of marketing exposure for both tobacco and e-cigarettes and each were scored on a scale of 0–4 (ie, 4 channels of marketing exposure × 4 possible frequencies × 2 types of products).

#### Covariates

Sociodemographic factors were included as covariates. Race/ethnicity was categorized as: White, non-Hispanic; Black, non-Hispanic;

Hispanic; and “other” (ie, Asian, American Indian/Alaska Native, Native Hawaiian/Other Pacific Islander). Sex was dichotomized into male (coded as 0)/female (coded as 1). Grade level was coded as middle school (0) or high school (1).

#### Statistical Analysis

Prior to testing study hypotheses, covariates were compared among tobacco use groups using Chi-squared analysis. Multivariable multinomial logistic regression models were used to examine the association of marketing exposure and tobacco use behaviors among US adolescents, controlling for sex, race/ethnicity, and grade level. A four-category dependent variable was used to examine total past 30-day tobacco use. The four categories of past 30-day use were: nonusers, past 30-day single product users, past 30-day dual product users, and past 30-day poly product users.

Three multivariable multinomial logistic regression analyses were performed, and each model controlled for sociodemographic factors. For model one, nonusers were used as the referent group. This analysis allowed for examination of the relationship of marketing exposure and nontobacco use, relative to each use category (ie, single, dual, and poly). For model two, past 30-day single product users served as the referent group, allowing for examination of the relationship between marketing exposure and past 30-day single product use, relative to past 30-day dual use and past 30-day poly use. For model three, past 30-day dual product users served as the referent group allowing for examination of the relationship between marketing exposure and past 30-day dual product use relative to past 30-day poly use. The permutation (ie, allowing each use category to serve as the referent group) of these analyses allows for a comprehensive examination of the relationships between all groups included in the analysis. Rather than only comparing nontobacco users to single product users, dual product users, and poly product users, this model computes all possible group comparisons in order to compare single users to dual users, single users to poly users, and dual users to poly users.

Data were weighted to be representative of US middle school and high school students and to adjust for nonresponse and probability of selection. All analyses were conducted using STATA 14.0 (College Station, TX).

## Results

### Descriptive Statistics

As seen in Table 1, 82.8% of adolescents reported no tobacco use, 8.8% reported using only one product, 4.1% reported using two products, and 4.4% reported using three or more tobacco products, in the past 30 days. The most commonly used product was e-cigarettes (9.3%), followed by conventional cigarettes (6.3%). As seen in Table 2, more than half of all cigarette (54.9%), cigar (57.4%), and smokeless tobacco (53.5%) users and a majority of snus (80.2%), dissolvable (86.1%), pipe (86.5%), and bidi (71.6%) smokers/users were polytobacco users. Further, about two-thirds of all e-cigarette users (63.7%) and hookah (69.3%) users were dual or polytobacco users. Chi-square tests revealed that males (relative to females) and high school (relative to middle school) students were more likely to be single, dual, or polytobacco users. There were statistically significant differences in tobacco use by race/ethnicity, with African American students having the lowest prevalence of any tobacco use (13.1%) and the lowest prevalence of dual (2.2%) and poly (1.8%) tobacco use, relative to other race/ethnic groups.

**Table 1.** Descriptive Statistics by Tobacco Use Category (National Youth Tobacco Survey 2014,  $n = 20\,685$ )

	Nonusers <sup>a</sup> ( $n = 17\,096$ ) <sup>b</sup>	Single users <sup>a</sup> ( $n = 1822$ ) <sup>b</sup>	Dual users <sup>a</sup> ( $n = 885$ ) <sup>b</sup>	Poly users <sup>a</sup> ( $n = 882$ ) <sup>b</sup>	Chi-square ( $df, N$ ) $p$ -value
Percent of sample	82.8%	8.8%	4.1%	4.4%	
	Demographics <sup>c</sup>				
Sex					
Males	80.4% (78.6–82.0)	9.4% (8.5–10.3)	4.5% (4.0–5.0)	5.8% (4.9–6.8)	$X^2(1, N = 20\,685) = 25.86,$ $p \leq .001$
Females	85.1% (83.7–86.5)	8.2% (7.3–9.1)	3.7% (3.2–4.3)	3.0% (2.6–3.6)	
Grade <sup>d</sup>					
Middle school	92.4% (91.1–93.5)	4.6% (3.7–5.7)	1.5% (1.2–1.8)	1.6% (1.1–2.1)	$X^2(1, N = 20\,685) = 99.03,$ $p \leq .001$
High school	75.5% (73.3–77.5)	11.9% (10.9–12.9)	6.1% (5.3–6.9)	6.6% (5.7–7.6)	
Race/ethnicity					
Non-Hispanic White	82.3% (80.5–84.1)	8.0% (7.1–9.0)	4.5% (3.9–5.2)	5.2% (4.4–6.2)	$X^2(3, N = 20\,685) = 7.35,$ $p \leq .001$
African American	86.9% (85.2–88.5)	9.1% (7.7–10.7)	2.2% (1.6–2.9)	1.8% (1.2–2.6)	
Hispanic/Latino	80.3% (81.2–86.6)	10.7% (6.6–9.9)	4.3% (3.3–5.1)	4.7% (2.5–5.4)	
Other	84.1% (81.4–85.1)	8.1% (8.0–9.5)	4.1% (3.7–4.5)	3.7% (3.8–5.1)	

<sup>a</sup>Corresponds to the number of tobacco products used in past 30 days.

<sup>b</sup>Unweighted sample size.

<sup>c</sup>Row may not add up to 100% due to rounding. Included below the prevalence is the 95% confidence interval.

<sup>d</sup>“Middle School” was classified as 6th–8th grade; “High School” was classified as 9th–12th grade.

“Other” is where a response was “Asian, non-Hispanic,” “American Indian/Alaska Native, non-Hispanic,” or “native Hawaiian and other Pacific Islanders, non-Hispanic”.

**Table 2.** Past 30-Day Single, Dual, and Poly Use by Tobacco Product (National Youth Tobacco Survey 2014,  $n = 20\,685$ )

Tobacco product	Product prevalence	Single users <sup>a</sup> ( $n = 1822$ ) <sup>b</sup>	Dual users <sup>a</sup> ( $n = 885$ ) <sup>b</sup>	Poly users <sup>a</sup> ( $n = 882$ ) <sup>b</sup>
Cigarettes ( $n = 1307$ )	6.3%	18.6%	26.5%	54.9%
E-cigarettes ( $n = 1919$ )	9.3%	36.3%	26.7%	37.0%
Cigar products ( $n = 1119$ )	5.4%	20.7%	21.9%	57.4%
Smokeless ( $n = 735$ )	3.6%	26.5%	20.0%	53.5%
Hookah ( $n = 1264$ )	6.1%	30.7%	28.3%	41.0%
Snus ( $n = 243$ )	1.2%	2.7%	17.1%	80.2%
Pipe ( $n = 226$ )	1.1%	5.0%	8.5%	86.5%
Bidis ( $n = 144$ )	0.6%	19.8%	8.6%	71.6%
Dissolvables ( $n = 91$ )	0.4%	5.3%	8.6%	86.1%

Rows of last three columns (ie, single, dual, and poly users) should equal 100%.

<sup>a</sup>Corresponds to the number of tobacco products used in past 30 days.

<sup>b</sup>Unweighted sample size.

### Nonusers as Referent Group

The first multinomial regression model assessed the relationship between marketing exposure and risk of single, dual, and polytobacco use; nonusers served as the reference group, see Table 4. This model indicated that for each additional level of exposure to another channel of marketing, when controlling for sociodemographics, the relative risk for single product use relative to nonusers increased by a factor of 1.03 (95% confidence interval [CI] = 1.02–1.05). Similarly, the relative risk for dual product use relative to nonuse increased by a factor of 1.06 (95% CI = 1.04–1.07), when controlling for covariates. Further, the relative risk of poly product use relative to nonuse increased by a factor of 1.07 (95% CI = 1.06–1.08), when controlling for covariates.

### Single Product Users as Referent Group

The second multinomial regression model assessed the relationship between marketing exposure and relative risk of dual and polytobacco use, with single product users as the referent group. This model indicated that for each additional exposure to another channel of marketing, when controlling for covariates, the relative risk for dual product use relative to single product use increase by a factor of 1.02 (95% CI = 1.00–1.04). The relative risk for poly product use relative to single product use increased by a factor of 1.03 (95% CI = 1.02–1.05), when controlling for covariates.

### Dual Product Users as Referent Group

The third multinomial regression model assessed the relative risk of polytobacco use with dual tobacco product use as the referent group. This model revealed no statistical difference in past 30-day poly product use relative to dual product use, controlling for covariates.

## Discussion

This study observed a positive relationship between tobacco marketing exposure and single, dual, and polytobacco use in the past 30 days, relative to nonusers. To our knowledge, this is the first study to examine the association between tobacco/e-cigarette marketing and past 30-day single, dual, and polytobacco use. This study furthers the understanding of the role marketing plays on the modern landscape of tobacco use by examining the diversity of tobacco products used by adolescents.

An additional finding is the magnitude (ie, relative risk ratio) of the relationship between tobacco marketing exposure and tobacco use increased with the number of products used, relative to nonusers. Specifically, this study found that when using nonusers as the referent group, the relative risk ratio of tobacco marketing exposure grew from single to dual to polytobacco use. Similarly, this study found that when using single product users as the referent group, the

relative risk ratio of tobacco marketing exposure grew from dual to polytobacco use. There was a lack of statistical difference between dual and poly use. This outcome is noteworthy given previous research has found significant differences between risk factors for dual and polytobacco by sociodemographic factors,<sup>9,10</sup> tobacco use profile,<sup>9,10</sup> and psychosocial variables.<sup>9-11</sup> This null finding helps to inform the very limited research base on dual and polytobacco use, particularly within the domain of marketing exposure. Given that many variables have been identified as predictors of polytobacco use (relative to single or dual tobacco use), understanding that there was not an observed difference in the relationship of tobacco marketing

exposure and dual or poly use is an expansion of a still-developing literature on dual and polytobacco use.

This study has two primary public health implications. First, self-reported exposure to tobacco/e-cigarette marketing is widespread among adolescents for all tobacco product categories (Table 3). Second, this widespread exposure to tobacco/e-cigarette marketing appears to not only be associated with use of a single tobacco product (eg, cigarettes, e-cigarettes),<sup>3,16-20</sup> but also multiple tobacco products. The potential role of marketing in the evolution in tobacco use behaviors warrants continued study given that the public health gains made by reductions in cigarette use may be undermined by use of other tobacco products.

This study also has regulatory implications. Specifically, tobacco regulations and restrictions vary substantively by product. For example, marketing restrictions for conventional cigarettes include those from the Master Settlement Agreement which prohibits public event sponsorship by tobacco companies,<sup>36</sup> as well as from the Family Smoking Prevention and Tobacco Control Act of 2009 (Tobacco Control Act) which prohibits free product giveaways and brand-name nontobacco promotional items.<sup>37,38</sup> Products such as smokeless tobacco and roll-your-own tobacco are regulated under the Tobacco Control Act but are not subject to the Master Settlement Agreement.<sup>35-38</sup> Similarly, products such as e-cigarettes, hookah, and cigar products were not included within the purview of the Tobacco Control Act until 2016<sup>37,38</sup> and the application of these regulations have yet to go into effect.

The limited marketing regulations on smokeless tobacco and lack of marketing regulations for e-cigarettes, hookah, and cigars, allows for the marketing of noncigarette products via channels not available to conventional cigarettes.<sup>33,35</sup> It is well-established marketing messages resonate with youth, and has been causally linked to the use of tobacco products.<sup>1</sup> As such, marketing campaigns for these products have incorporated celebrity sponsorship, radio and television advertisements, event sponsorship, and internet/social media marketing.<sup>14,39,40</sup> As these products are utilizing marketing tactics previously used for cigarettes, it is important to understand the cumulative effect of the marketing of these non-cigarette products.

**Table 3.** Self-Reported Marketing Exposure by Product, Channel, and Tobacco Use Group (National Youth Tobacco Survey 2014,  $n = 20685$ )

	Nonusers <sup>a</sup> ( $n = 17096$ ) <sup>b</sup>	Single users <sup>a</sup> ( $n = 1822$ ) <sup>b</sup>	Dual users <sup>a</sup> ( $n = 885$ ) <sup>b</sup>	Poly users <sup>a</sup> ( $n = 882$ ) <sup>b</sup>
<b>Tobacco marketing</b>				
Mean (SD) <sup>c</sup>	7.3 (3.1)	7.6 (3.2)	7.9 (3.3)	7.9 (3.4)
Retail <sup>d</sup>	2.6 (1.2)	2.7 (1.2)	2.8 (1.2)	2.8 (1.2)
Internet <sup>d</sup>	2.5 (1.0)	2.7 (1.1)	2.7 (1.1)	2.6 (1.1)
Print <sup>d</sup>	1.3 (0.9)	1.4 (1.0)	1.5 (1.0)	1.4 (1.1)
TV/movies <sup>d</sup>	1.9 (1.0)	2.0 (1.1)	2.00 (1.1)	2.0 (1.1)
<b>E-cigarette marketing</b>				
Mean (SD) <sup>c</sup>	5.3 (3.4)	6.1 (3.5)	6.7 (3.6)	7.1 (3.7)
Retail <sup>d</sup>	1.7 (1.2)	1.9 (1.2)	2.1 (1.3)	2.3 (1.2)
Internet <sup>d</sup>	1.2 (1.0)	1.5 (1.1)	1.6 (1.1)	1.7 (1.2)
Print <sup>d</sup>	1.2 (0.9)	1.3 (1.0)	1.5 (1.0)	1.5 (1.1)
TV/movies <sup>d</sup>	1.2 (1.1)	1.4 (1.1)	1.5 (1.2)	1.6 (1.2)
<b>Total marketing</b>				
Mean (SD) <sup>c</sup>	12.6 (5.8)	13.8 (6.1)	14.5 (6.3)	14.9 (6.4)

<sup>a</sup>Corresponds to the number of tobacco products used in past 30 days.

<sup>b</sup>Unweighted sample size.

<sup>c</sup>Possible score of 0–16 (channel × frequency).

<sup>d</sup>Possible score of 0–4 (“never/rarely,” “sometimes,” “most of the time,” or “always”).

<sup>e</sup>Possible score of 0–32 (channel × frequency × products).

**Table 4.** Multinomial Logistic Regression Models of Cumulative Marketing Exposure and Past 30-day Tobacco Use (National Youth Tobacco Survey, 2014;  $n = 20685$ )

	Nonusers <sup>a</sup> ( $n = 17096$ ) <sup>b</sup>	Single users <sup>a</sup> ( $n = 1822$ ) <sup>b</sup>	Dual users <sup>a</sup> ( $n = 885$ ) <sup>b</sup>	Poly users <sup>a</sup> ( $n = 882$ ) <sup>b</sup>
	Relative risk ratio (95% confidence interval)	Relative risk ratio (95% confidence interval)	Relative risk ratio (95% confidence interval)	Relative risk ratio (95% confidence interval)
<b>Nonuser as referent</b>				
Marketing exposure <sup>c</sup>	1.00 (Ref)	<b>1.03* (1.02–1.05)</b>	<b>1.06* (1.04–1.07)</b>	<b>1.07* (1.06–1.08)</b>
<b>Single as referent</b>				
Marketing exposure <sup>c</sup>	—	1.00 (Ref)	<b>1.02* (1.00–1.04)</b>	<b>1.03* (1.02–1.05)</b>
<b>Dual as referent</b>				
Marketing exposure <sup>c</sup>	—	—	1.00 (Ref)	1.01 (0.99–1.03)

All models adjusted for grade level, sex, and race. Bold indicates statistical significance.

<sup>a</sup>Corresponds to the number of tobacco products used in past 30 days.

<sup>b</sup>Unweighted sample size.

<sup>c</sup>Sum of number of product marketing sources exposed (0–32).

\* $p < .001$ .

Along with the lack of regulation of product marketing, substantial dollars are allocated to market nongarette products. E-cigarette marketing has grown significantly since these products were introduced, from \$6.4 million spent on TV, radio, internet, and print media in all of 2011 to \$28 million through half of 2013.<sup>41</sup> Annual smokeless tobacco marketing expenditures nearly doubled from 2002 (\$235 million) to 2010 (\$444 million) and remained steady through 2014.<sup>12</sup> This widespread marketing exposure has been linked to increased product awareness<sup>42</sup> and product use<sup>16,43</sup> among adolescents. Furthermore, promotional tactics for these products have specifically targeted existing tobacco users.<sup>21–25,44</sup> For example advertisements and price discount promotions of smokeless tobacco directly encouraging dual use.<sup>21–25</sup> The combination of minimal regulation, substantial marketing expenditures, and overt promotion of multi-tobacco product use are likely contributing to the relationships observed in this study. Policies and programs should be considered to combat the influences of this marketing on adolescents.

This study has some limitations. First, causal inferences cannot be drawn as these data are cross-sectional. Longitudinal research is needed to examine the temporal relationship between marketing and dual or polytobacco use. A second limitation is the possibility of recall bias via self-reported data. Product users may be more likely to notice or recall tobacco marketing, thus reporting greater exposure. Third, it is possible that study participants interpreted the “how often do you see ads or promotions for [cigarettes or other tobacco products]” to include e-cigarettes, thus resulting in an over-estimated exposure variable and biased (ie, inflated) association between marketing exposure and these tobacco use behaviors. However, the development of the survey included cognitive interviewing with this population and we did not detect this misinterpretation.<sup>32</sup> And finally, marketing exposure for conventional tobacco products did not differentiate by products (eg, cigarettes, cigars, etc.). Despite these limitations, this study expands the understanding of the relationship between marketing exposure and adolescent tobacco use behaviors. Specifically, this research extends the literature by demonstrating an association between tobacco marketing exposure and use of not just a single product (eg, conventional cigarettes) but of multiple tobacco products. Further, by incorporating exposure to cigarette, e-cigarette, and other tobacco marketing, this study allows for a more comprehensive understanding of effects of adolescent tobacco marketing exposure.

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## Declaration of Interests

None declared.

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