



Sociodemographic differences in young adults' recall of tobacco and cannabis marketing online and in television/film

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ABSTRACT

Young adults (YA) who report viewing pro-tobacco and cannabis marketing are at increased risk for using tobacco and cannabis. However, there is a growing diversity of tobacco and cannabis products on the market, as well as methods for marketing them. Prevalence of, and sociodemographic differences in, YA's recall of various types of tobacco and cannabis marketing is not well-characterized. Data were from a cohort of YA (mean age: 19.8) from Southern California in 2019. Respondents were asked whether they recalled having seen two types of marketing (online advertisements and portrayals of product use in TV/movies) for 5 tobacco and 3 cannabis products among never-users of tobacco (N = 954) and cannabis (N = 1,046), respectively. Sociodemographic differences in marketing recall were subsequently assessed. Among tobacco-naïve respondents, 31.3% and 49.3% recalled seeing online advertisements and tobacco use in TV/movies, respectively. Among cannabis-naïve respondents, 18.7% and 31.0% recalled seeing online advertisements and cannabis use in TV/movies, respectively. Overall, respondents recalled seeing tobacco and cannabis products on TV/movies at higher rates than seeing online advertisements, with the exception of electronic cigarettes, for which online advertisements were seen at higher rates. Women (vs. men) had higher odds of seeing tobacco (aOR = 1.9) and cannabis use in TV/movies (aOR = 1.4) and cannabis marketing online (aOR = 1.4). LGB (vs. straight) respondents had higher odds of seeing cannabis marketing online (aOR = 1.7). Efforts to regulate exposure to tobacco and cannabis marketing among young women and LGB people merit further consideration.

1. Introduction

Tobacco companies have long employed numerous tactics to advertise their products to youth and young adults (YA; e.g., through television, films, music videos, and in magazines) (Cummings et al., 2002), and young people who report viewing tobacco advertisements are at greater risk for tobacco use initiation, progression to regular use, and development of nicotine dependence (Biener and Siegel, 2000; Hanewinkel et al., 2011; Henriksen et al., 2010; Cruz et al., 2019; Lovato et al., 2011; Soneji et al., 2018). As a result, the 1998 Tobacco Master

Settlement Agreement (MSA) limited the marketing of tobacco products in ways that might entice underaged youth to use them (e.g., displaying advertisements on billboards, placing direct advertisements on television (TV) and movies, use of cartoon characters such as "Joe Camel") (Truth Initiative, 2020; Public Health Law Center, 2020). However, following passage of the MSA, more subtle product placement strategies continued to be used in TV and movie productions with tobacco products featured as a part of the plot or character development. Similar to direct tobacco advertising, viewing tobacco products on TV/movies is also positively associated with youth tobacco use (Dalton et al., 2003;

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Sargent et al., 2001; Tickle et al., 2001; Wellman et al., 2006).

Several U.S. states, including California, legalized the sale, possession, and use of cannabis recreationally among adults, beginning in 2012 (Walsh, 2013). Commercialization and marketing of cannabis products began shortly afterwards (Fiala et al., 2018, 2020). However, unlike with tobacco, there are relatively few restrictions on cannabis marketing, in part because cannabis is classified federally as a schedule I drug despite legal sales of recreational cannabis in 11 states and the District of Columbia (US Drug Enforcement Administration). Consistent with studies that show viewing tobacco marketing increases risk for tobacco use, a small body of cross-sectional work has also shown that viewing cannabis advertisements is associated with higher odds of cannabis use (Dai, 2017; Rup et al., 2020), as is seeing cannabis use in TV/movies (Hunt et al., 2011).

The tobacco and emerging cannabis marketplaces have changed considerably over the past decade, resulting in a proliferation of new tobacco and cannabis products (e.g., electronic cigarettes and cannabis vaping), which have become increasingly popular among YA (Dai and Leventhal, 2019; King et al., 2018; Schulenberg et al., 2019). There is also evidence that tobacco and cannabis companies are marketing these products in new (and largely unregulated) ways – through online platforms such as social media (O'Brien et al., 2020; Cruz et al., 2019), which may disproportionately impact YA who rely on the Internet more heavily than older adults (Pew Research Center, 2019). For example, a recent study examining JUUL's (a popular e-cigarette brand) marketing campaign revealed that thousands of Instagram posts, emails, and other advertisements were targeted to youth, and non-smoking populations (Jackler et al., 2019). Similarly, Medmen (an emerging national cannabis retailer) recently initiated a well-funded national advertising campaign, including advertisements on the *Howard Stern* and *Adam Carolla* shows, YouTube videos, billboards, and social media advertisements (Ayers et al., 2019). Given the increasing array of tobacco and cannabis products and methods for marketing them (e.g., online via social media), it is important to identify the extent to which YA recall seeing marketing, for which products, and through which channels (e.g., online, via TV/movies).

Marginalized populations, including sexual and gender minorities, racial/ethnic minorities, and populations of lower socioeconomic status, use tobacco and cannabis products at higher rates, relative to the national average (Barger et al., 2021; Dai and Hao, 2017; Du et al., 2019; Peters et al., 2018). Historically, these groups have also been disproportionately exposed to cigarette advertisements targeted specifically to minority populations (Cruz et al., 2019; Dauphinee et al., 2013; Emory et al., 2018; Higgins et al., 2019; Rising and Alexander, 2011; Liemann et al., 2019). However, little is known about whether, or how viewing of marketing for new and emerging tobacco and cannabis products differs across sociodemographic characteristics, such as race/ethnicity, gender identity, sexual identity, and socioeconomic status in YA.

This study had two aims. First, we assessed prevalence of recalling online advertisements, as well as seeing product use in TV/movies, for a wide range of tobacco and cannabis products among a diverse sample of YA (mean age: 19.8, under the legal age to purchase both tobacco and (recreational) cannabis products in California (Zhang et al., 2018; California, 2021)) from Southern California. Second, we assessed sociodemographic differences in recalling online advertisements and seeing product use in TV/movies for any tobacco products and any cannabis products. All analyses were limited to never-users of tobacco and cannabis products, respectively.

2. Methods

2.1. Study design

Data were from a prospective school-based cohort study of adolescent and YA substance use (Leventhal et al., 2015). Respondents were

recruited from 10 high schools in Los Angeles, CA in fall 2013, when they were in 9th grade (mean age: 14.1; $N = 3,396$). Data from the most recent wave of data collection (collected via internet in January–September 2019) were used for the present analyses (mean age: 19.8; $N = 2,548$), when questions related to viewing tobacco and cannabis marketing were first introduced. All respondents with complete demographic information and valid responses to the marketing questions were eligible for the current study. Further, to best understand the degree to which YA most at risk for initiation of tobacco or cannabis use recalled seeing pro-tobacco and cannabis marketing, analyses which assessed tobacco product marketing were restricted to never-tobacco users ($N = 959$) and analyses which assessed cannabis product marketing were restricted to never-cannabis users ($N = 1,051$). Parents provided written or verbal informed consent, and students provided assent prior to enrollment in the study. Respondents were re-consented after completing high school. The study was approved by the institutional review board at the University of Southern California.

2.2. Study variables

Recall of online advertisements was assessed with the question, “When you are using the Internet, how often do you see ads for these products? (0 = I do not use the internet, 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Most of the time, 5 = Always)” For tobacco products, response categories were “cigarettes,” “cigar, cigarillo, or little cigar,” “smoking tobacco from a hookah or waterpipe,” “JUUL,” or “other electronic tobacco products.” For cannabis products, response categories were “smoking marijuana,” “vaping marijuana,” and “edible marijuana.” For each question, responses were dichotomized (0 = never or rarely saw; 1 = sometimes, most of the time, or always saw). Composite scores were also created for recall of any online tobacco advertisements (i.e., exposure to 1 or more of the tobacco product advertisements) and any online cannabis (i.e., exposure to 1 or more of the cannabis product advertisements) advertisements.

Recall of product use in television and movies was assessed with the question, “When you watch TV or go to the movies, how often do you see actors using these products? (0 = I do not watch TV or go to the movies, 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Most of the time, 5 = Always).” Items were dichotomized in the same way as described for online advertisements, and composite scores were also created for recall of any tobacco and cannabis use in television and movies, as noted above.

Lifetime tobacco and cannabis use were assessed with the question, “Have you ever used any of the following substances in your life (0 = No, 1 = Yes)” for cigarettes, electronic cigarettes, cigars, little cigars or cigarillos, hookah, blunts, smoking marijuana, electronic marijuana, edible marijuana, synthetic marijuana, and dabs. All tobacco (cigarettes, electronic cigarettes, cigars, little cigars or cigarillos, hookah, and blunts) and cannabis products (blunts, smoking marijuana, electronic marijuana, edible marijuana, synthetic marijuana, and dabs) were combined to assess whether respondents had used at least 1 tobacco or cannabis product in their life, respectively. All analyses were limited to never users ($N = 959$ for tobacco, $N = 1,046$ for cannabis). Blunts were included in both composite variables to conservatively limit each of the samples to never-users.

Sociodemographic characteristics. Gender identity was assessed using the “two-step procedure” (GenUSS Group, 2013) using two questions: “What is your sex assigned at birth,” (male, female) and “With which gender identity do you most identify” (male/masculine, female/feminine, transgender male, transgender female, gender variant/non-binary, additional gender category, prefer not to disclose). Respondents were categorized according to their current gender identity as follows: man (male/masculine), woman (female/feminine), transgender/non-binary (if identified as transgender male, transgender female, gender variant/non-binary, additional gender category, or if sex assigned at birth did not align with current gender identity), or prefer not to disclose (recoded as missing). For sexual identity, respondents

were asked “do you consider yourself to be:” (single choice: asexual, bisexual, gay, straight, lesbian, pansexual, queer, questioning or unsure, another identity not listed here, prefer not to disclose). Respondents were categorized as straight, LGB (lesbian, gay, bisexual), or plurisexual (pansexual, queer). Other responses were marked as missing for sexual identity (N = 170). Race/ethnicity was assessed using the question “please choose one term that best describes you,” (American Indian or Alaska Native, Asian, Black or African American, Hispanic or Latino, Native Hawaiian or Pacific Islander, White, Multiracial, Other), which was collapsed into a 6-level variable (Hispanic, Asian, White, Black, Other, Multiracial). Current enrollment in a degree program was assessed with the question, “Are you currently enrolled in a degree program?” (yes, no, don’t know). Those responding “don’t know” were recoded as “no.”

2.3. Data analysis

Sociodemographic characteristics were first calculated, separately among never users of tobacco and cannabis products (see supplemental table 1 for comparisons between never- and ever-users of tobacco and cannabis). Then, prevalence estimates were calculated for recalling seeing tobacco and cannabis marketing. Unadjusted estimates are reported for both Internet- and TV/movie-based marketing, and F-tests assessed whether prevalence differed significantly by marketing source for each product. Finally, sociodemographic differences were assessed for recall of marketing for any tobacco (1 or more products) or cannabis (1 or more products) products, separately for Internet- and TV/movie-based marketing channels. Pairwise comparisons assessed whether response categories of each sociodemographic characteristic (e.g., men vs. women) differed significantly from one another. Multivariable logistic regressions also assessed associations between all sociodemographic characteristics, in combination, on recalling any tobacco and any cannabis marketing. All analyses were limited to never-users of tobacco (for tobacco marketing analyses) and cannabis (for cannabis marketing analyses) and were conducted in 2020 using Stata SE version 15. Sample characteristics of users vs. never-users of tobacco and cannabis were compared in Supplemental Table 1.

3. Results

3.1. Study sample characteristics

Among never tobacco and cannabis users, respectively, the majority of respondents identified as women (56.5%, 54.4%), and 1.4% and 1.2%, respectively identified as transgender/non-binary (Table 1). Roughly 10% of both samples identified with a non-straight sexual identity. The largest percentage of both samples were Latinx/Hispanic (45.0% and 44.2%, respectively). Over half of both samples were enrolled in a degree seeking program (70.1% and 69.4%, respectively).

3.2. Prevalence of recalling marketing by source across different tobacco and cannabis products

Among never-users of tobacco, 31.3% recalled seeing tobacco advertisements online, while nearly half (49.3%) reported seeing tobacco products on TV/movies. Among never cannabis users, 18.7% recalled seeing online cannabis advertisements, while 31.0% recalled seeing cannabis products on TV/movies (Table 1). For all comparisons except vaping marijuana, there were significant differences ($p < 0.05$) in the proportions of respondents who recalled seeing online advertisements for tobacco and cannabis products and those who recalled seeing product use in TV/movies (Fig. 1). By and large, respondents recalled seeing tobacco and cannabis products in TV/movies at higher rates than online advertisements (e.g., for cigarettes: 46.0% in TV/movies vs. 14.7% online; for smoking cannabis: 29.9% in TV/movies vs. 17.2% online), with the exception of JUUL and other electronic cigarettes. For

Table 1
Sample characteristics among never users of tobacco and cannabis.

	Never Users of Tobacco (N = 954)		Never Users of Cannabis (N = 1,046)	
	N	%	N	%
Recalled Seeing Marketing				
Internet				
Tobacco	299	31.3	336	32.1
Cannabis	174	18.2	196	18.7
TV/Movies				
Tobacco	470	49.3	496	47.4
Cannabis	309	32.4	324	31.0
Lifetime Tobacco and Cannabis Use ^a				
Tobacco	–	–	186	17.8
Cannabis	94	9.9	–	–
Sociodemographic Characteristics				
Gender identity				
Man	402	42.1	464	44.4
Woman	539	56.5	569	54.4
Transgender/Non-binary	13	1.4	13	1.2
Sexual Identity				
Straight	861	90.3	951	90.9
LGB	79	8.3	81	7.7
Plurisexual	14	1.5	14	1.3
Race/Ethnicity ^b				
White	139	14.6	163	15.6
Latinx/Hispanic	429	45.0	462	44.2
Asian	218	22.9	228	21.8
Black	49	5.1	51	4.9
Other	69	7.2	93	8.9
Multirace	50	5.2	49	4.7
Enrolled in a Degree Program				
Yes	669	70.1	726	69.4
No	285	29.9	320	30.6

a. 860 respondents reported never using any tobacco or any cannabis products. This translates to 90.1% of never tobacco users who have also never tried cannabis and 82.2% of never cannabis users who have also never tried tobacco.
b. “Other” race/ethnicity is inclusive of American Indian or Alaska Native, Native Hawaiian or Pacific Islander, and self-identified other races

those products, respondents recalled seeing advertisements online at higher rates than they did seeing product use on TV/movies (JUUL: 10.7% in TV/movies vs. 22.0% online, other electronic cigarettes: 17.5% in TV/movies vs. 26.1% online).

Among never-users of either tobacco or cannabis, there were small degrees of overlap in recalling both tobacco and cannabis online advertisements (16.0%) and seeing use of both tobacco and cannabis in TV/movies (31.1%, see Supplemental Table 2).

3.3. Sociodemographic comparisons in recalling tobacco and cannabis marketing

There were no differences between sociodemographic subgroups in recalling seeing online tobacco advertisements, in either bivariate or multivariable analyses (Table 2). However, several differences emerged for seeing tobacco use in TV/movies. Compared to men, women had nearly double the odds of seeing tobacco use in TV/movies (aOR = 1.9, CI = 1.5, 2.5). Black respondents had less than half the odds of seeing tobacco use in TV/movies, compared to White respondents (aOR = 0.4, CI = 0.2, 0.8).

Several sociodemographic differences were found in recalling seeing online cannabis advertisements and seeing cannabis use in TV/movies. Women (aOR = 1.6, CI = 1.1, 2.2) and LGB-identified respondents (aOR = 1.7, CI > 1.0, 3.0) had greater odds of seeing online cannabis advertisements, as compared to men and straight respondents, respectively. Asian respondents had lower odds of perceived online cannabis advertisement exposure, compared to White respondents (aOR = 0.6, CI = 0.3, <1.0). Women (aOR = 1.4, CI = 1.1, 1.9) and transgender/non-binary respondents (aOR = 3.7, CI = 1.1, 12.0) reported higher odds of seeing cannabis products in TV/movies, compared to men. Asian

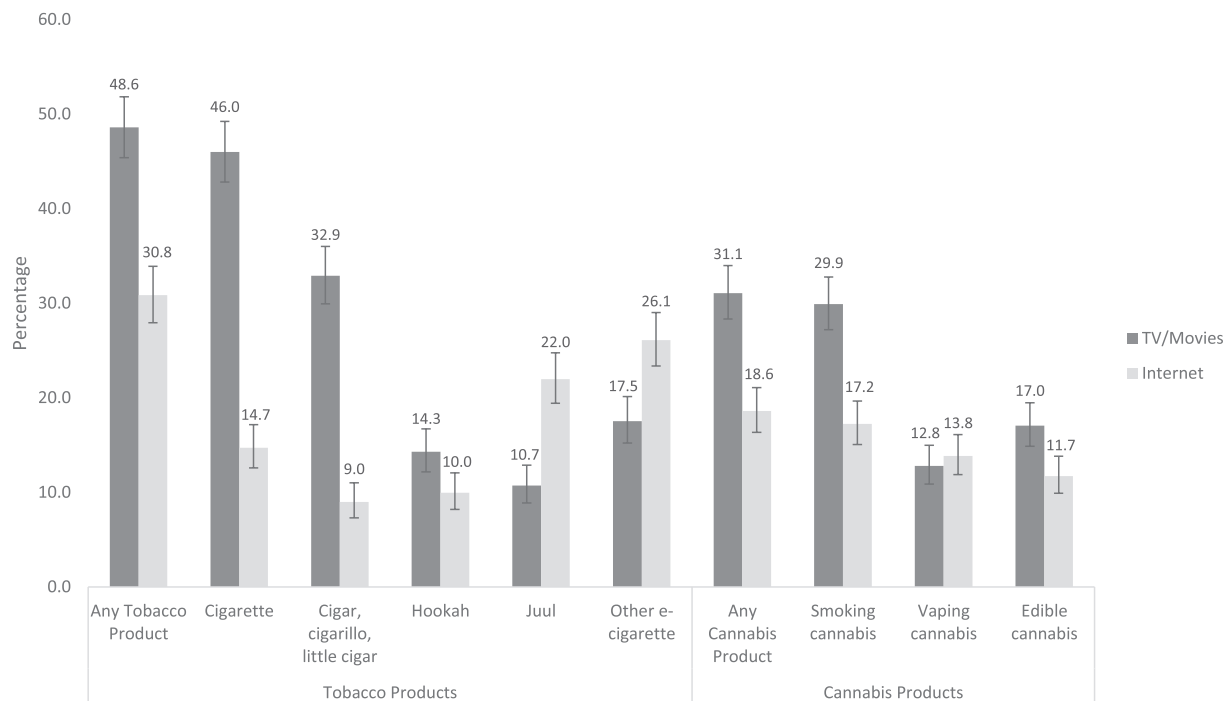


Fig. 1. Prevalence of Seeing Marketing by Source Among Never Users Note: Reported prevalence estimates for tobacco products are among never-users of tobacco products. Reported prevalence estimates for cannabis products are among never-users of cannabis products. All comparisons between TV/Movie and Internet-based advertisements are significant ($p < 0.05$) except for vaping marijuana.

(aOR = 0.5, CI = 0.3, 0.7), Black (aOR = 0.4, CI = 0.2, 0.9), and Other race (aOR = 0.5, CI = 0.3, 0.8) respondents all reported lower odds than White respondents of seeing cannabis use in TV/movies.

Prevalence estimates for seeing tobacco and cannabis marketing by sociodemographic characteristic are presented separately for specific tobacco and cannabis products in Supplemental Tables 3 (online) and 4 (TV/movies), though statistical significance was not assessed due to insufficient analytic power.

4. Discussion

4.1. Young adults' recall of tobacco and cannabis marketing online and in television and movies

This study assessed prevalence of, and sociodemographic differences in recalling tobacco and cannabis product marketing among a sample of Southern California YA reporting no history of tobacco and cannabis use, respectively. For the majority of products – all combustible tobacco products, combustible cannabis, and edible cannabis – respondents had higher odds of seeing use of those products on TV/movies than they did seeing online advertisements. Portraying tobacco use in TV/movies has been an effective – and profitable – way to advertise tobacco products (Mekemson and Glantz, 2002), increasing risk for tobacco use initiation among youth (Distefan et al., 2004). While considerably less research has assessed the role of seeing cannabis products in TV/movies on initiation of cannabis use among young people, cannabis brands have been successful in negotiating product placements with entertainment studios, and with almost no regulation (Jones, 2018). While it is impossible to discern the degree to which respondents saw tobacco and cannabis products in TV/movies through intentional product placements and/or through the artistic discretion of the TV/filmmakers, our results highlight that shows and movies reaching young people include a considerable amount of tobacco and cannabis product use. Effective measures to reduce exposure to this form of marketing may include giving programs that display tobacco or cannabis use R (movies) and TV-MA (television) ratings and prohibiting the display of recognizable

brand names, among other actions. Consult the Truth Initiative (America's largest nonprofit public health organization devoted to ending tobacco use) for a full list of measures endorsed by the organization (Truth Initiative, 2019).

While there is ample evidence that JUUL and other e-cigarette brands are indeed promoted on TV/movies (Camenga et al., 2018; Wagoner et al., 2019; Willett et al., 2019), respondents in this sample had higher odds of recalling seeing online advertisements (vs. seeing use in TV/movies) for these products. Given that youth and YA remain the largest demographic group of Internet users (Pew Research Center, 2019), and that the proportion of young people using e-cigarettes has risen (from 1.5% of high schoolers in 2011 to 27.5% in 2019 CDC, 2019), online advertisements for e-cigarettes may disproportionately influence underaged youth and YA to experiment with, and become regular users of e-cigarettes. A future direction for effective tobacco regulation might include limiting online marketing for e-cigarette products. While logistically challenging, online marketing should ideally be regulated in such a way that ensures first amendment protections to e-cigarette companies, while also limiting exposure among YA never users (e.g., by allowing advertisements only through direct communications to adult current users) (Lindblom, 2015).

4.2. Sociodemographic differences in recall of tobacco and cannabis marketing

A number of sociodemographic differences were also found with regard to viewing tobacco and cannabis marketing. For example, women reported seeing online cannabis advertisements at higher rates than men. Compared to men, greater percentages of women also reported seeing tobacco and cannabis products on TV/movies. It is possible these findings stem from documented gender differences in processing and recall of advertising details, with women recalling details of advertisements more clearly than men (Martin, 2003). However, it is also plausible that young women (vs. men) who recall seeing tobacco and cannabis products in TV/movies may be at especially high risk for using those products themselves. In prior longitudinal work among non-

Table 2
Sociodemographic differences in recalling seeing tobacco and cannabis marketing.

	Internet Tobacco % (95% CI)	OR (95% CI)	Cannabis % (95% CI)	OR (95% CI)	TV/Movies Tobacco % (95% CI)	OR (95% CI)	Cannabis % (95% CI)	OR (95% CI)
Gender identity								
Man	29.9 (25.5, 34.5)	Ref	14.5 (11.6, 18.1)	Ref	39.6 (34.9, 44.4)	Ref	25.8 (22.0, 30.0)	Ref
Woman	31.8 (28.0, 35.9)	1.1 (0.8, 1.4)	22.1 (18.8, 25.7)	1.6 (1.1, 2.2)	56.1 (51.9, 60.3)	1.9 (1.5, 2.5)	34.9 (31.1, 38.9)	1.4 (1.1, 1.9)
Transgender/Non-binary	53.9 (28.1, 77.7)	2.6 (0.8, 8.4)	15.4 (3.9, 45.1)	0.9 (0.2, 4.4)	69.2 (40.9, 88.0)	3.1 (0.9, 10.9)	53.9 (28.1, 77.7)	3.7 (1.1, 12.0)
Sexual identity								
Straight	30.6 (27.6, 33.8)	Ref	18.0 (15.7, 20.6)	Ref	49.0 (45.6, 52.3)	Ref	30.9 (28.0, 33.9)	Ref
LGB	39.2 (29.1, 50.4)	1.4 (0.8, 2.2)	27.2 (18.6, 37.8)	1.7 (>1.0, 3.0)	51.9 (41.0, 62.7)	1.1 (0.6, 1.7)	33.3 (24.0, 44.3)	1.1 (0.6, 1.7)
Plurisexual	28.6 (11.1, 56.1)	0.7 (0.2, 2.3)	14.3 (3.6, 42.7)	0.7 (0.2, 3.3)	57.1 (41.6, 79.4)	1.0 (0.3, 3.0)	35.7 (15.7, 62.4)	0.8 (0.3, 2.7)
Race/ethnicity								
White	34.5 (27.1, 42.8)	Ref	19.8 (14.3, 26.6)	Ref	56.8 (48.5, 64.8)	Ref	37.7 (30.5, 45.4)	Ref
Latinx	32.9 (28.7, 37.6)	0.9 (0.6, 1.4)	22.8 (19.2, 26.9)	1.1 (0.7, 1.7)	48.8 (44.1, 53.6)	0.7 (0.5, 1.1)	35.4 (31.2, 39.9)	0.9 (0.6, 1.4)
Asian	28.4 (22.8, 34.8)	0.7 (0.5, 1.2)	12.8 (9.0, 17.8)	0.6 (0.3, <1.0)	50.0 (43.4, 56.6)	0.8 (0.5, 1.2)	22.0 (17.1, 27.9)	0.5 (0.3, 0.7)
Black	26.5 (16.1, 40.5)	0.7 (0.3, 1.4)	15.7 (8.0, 28.4)	0.7 (0.3, 1.7)	32.7 (21.1, 46.9)	0.4 (0.2, 0.8)	19.6 (10.9, 32.8)	0.4 (0.2, 0.9)
Other	26.1 (17.1, 37.7)	0.7 (0.3, 1.3)	15.2 (9.2, 24.1)	0.7 (0.3, 1.4)	46.4 (35.0, 58.1)	0.7 (0.4, 1.3)	21.7 (14.5, 31.3)	0.5 (0.3, 0.8)
Multi	32.0 (20.6, 46.0)	0.9 (0.4, 1.8)	12.2 (5.6, 24.7)	0.5 (0.2, 1.4)	50.0 (36.5, 63.5)	0.8 (0.4, 1.5)	40.8 (28.1, 55.0)	1.2 (0.6, 2.4)
Degree program								
Yes	31.8 (28.4, 35.5)	Ref	18.8 (16.1, 21.8)	Ref	52.5 (48.7, 56.2)	Ref	33.2 (29.8, 36.7)	Ref
No	29.9 (24.9, 35.5)	0.9 (0.7, 1.2)	18.3 (14.4, 23.0)	1.0 (0.7, 1.4)	41.9 (36.3, 47.7)	0.7 (0.5, 0.9)	26.5 (21.9, 31.6)	0.7 (0.5, 0.9)

Note: Reported prevalence estimates (unadjusted) and odds ratios for tobacco products are among never-users of tobacco products. Reported prevalence estimates (unadjusted) and odds ratios for cannabis products are among never-users of cannabis products. For the unadjusted prevalence estimates, pairwise comparisons assessed, within each sociodemographic characteristic, whether subgroups differed significantly from one another ($p < 0.05$). No pairwise differences were detected for online tobacco advertisements. For online cannabis advertisements, Latinx respondents reported significantly higher prevalence of exposure, compared to Asian and Multirace respondents. For tobacco use in TV/movies, White, Latinx, and Asian respondents all reported significantly higher prevalence of exposure, compared to Black respondents. Additionally, those enrolled in a degree program reported significantly greater exposure than those not enrolled. For cannabis use in TV/movies, White, Latinx, and Multirace respondents all reported significantly higher exposure than Asian, Black, and Other race respondents. Additionally, those enrolled in a degree program reported significantly greater exposure than those not enrolled. Boldface highlights significant ($p < 0.05$) findings.

smokers, young women who watched a favorite actor smoke on screen had a nearly twofold increase in risk for smoking themselves. This association was not significant among young men (Distefan et al., 2004). In multivariable analysis, LGB-identified YA also recalled seeing online cannabis advertisements at a higher rate than straight respondents, and prior research has shown that LGB youth have a greater willingness to use cannabis products than their straight peers (Gamarel et al., 2018). Together, these findings highlight that young women and LGB people may be priority populations for public health efforts to prevent tobacco and cannabis use.

Several racial/ethnic differences were found. Interestingly, racial/ethnic minority respondents had lower odds of recalling marketing, across a number of comparisons. For example, Asian YA had about half the odds of recalling seeing online cannabis advertisements and seeing use of cannabis products in TV/movies, compared to White respondents. Further, compared to White respondents, Black respondents had about 40% odds of recalling both tobacco and cannabis use in TV/movies, and respondents reporting an “other” race/ethnicity had about 50% odds of recalling cannabis use in TV/movies. While cigarette companies have a long history of targeting advertisements to Black populations (Balbach et al., 2003), our results suggest that among never-users, White YA are more likely to see online advertisements for tobacco and cannabis, or to see those products used in TV/movies. However, it should be noted that while this analysis was focused on identifying sociodemographic

disparities in seeing marketing, all groups did recall seeing some degree of marketing (e.g., among non-users of cannabis, Asian YA had 0.6 times the odds of seeing online cannabis ads. Yet more than one in ten Asian YA still recalled seeing online cannabis ads.).

4.3. Regulating cannabis products

Several steps have been taken at the state and federal levels to regulate underage exposure to tobacco marketing (FDA, 2019). However, while many U.S. states have legalized the sale of cannabis products, they remain illegal federally. This limits the ability to effectively regulate accessibility to cannabis products for adults and those who may benefit from them (e.g., medical cannabis), while also limiting exposure to those most vulnerable to misuse (e.g., YA). Respondents in this sample were below the legal purchasing age for cannabis products in California, yet a large proportion of them – all of whom reported never using cannabis in the past – reported seeing online advertisements and use of these products in TV/movies. These results highlight a need for more research related to cannabis marketing exposure and subsequent use among YA, and the role of regulations to limit exposure. While individual states may be unable to regulate online advertisements, they would be able to regulate local advertisement (e.g., in storefronts), should they be shown to deliberately and effectively target underage youth. More work is still needed to understand how to effectively regulate pro-use

messages online and in TV/movies.

4.4. Limitations

First, our main outcome measure was self-reported recall of tobacco and cannabis marketing, which may not reflect actual marketing efforts to place ads where YA will see them. Instead, our measure signifies where YA were most likely to notice tobacco and cannabis advertisements. Second, these analyses were cross-sectional; we were unable to assess whether recalling marketing was associated with tobacco and cannabis use initiation. Third, this study assessed whether respondents recalled seeing marketing both online and in TV/movies, though there exist a host of other ways in which tobacco and cannabis products are marketed (e.g., billboards, storefronts, print media, television commercials for e-cigarettes). Additional research is needed to understand YA exposure to pro-tobacco and cannabis marketing across a wider range of marketing platforms. Further, tobacco products are marketed online largely via organic social media posts not labeled as advertising (Jackler et al., 2019). Since respondents were asked generally about seeing ads “when using the internet,” we were unable to disentangle the various types of online marketing YA saw. Fifth, patterns of media consumption vary among YA (Ilakkuvan et al., 2019), and heavy media users may recall more tobacco and cannabis marketing than light media users. While respondents were able to indicate if they did not use the Internet or if they did not watch TV/movies at all, we were otherwise unable to account for the frequency or timing of their Internet or TV/movie consumption. Sixth, these data are from a cohort of YA from Southern California, and so may not reflect national or regional trends in perceived marketing exposure. However, the sample was similar to population characteristics of Los Angeles, CA in terms of race/ethnicity and educational attainment (US Census Bureau, 2019). To reduce survey burden, respondents were not asked to report on all characteristics that may potentially be related to substance use (e.g., religiosity). Finally, small sample sizes in some of the sociodemographic subgroups (e.g., transgender/non-binary respondents) and in some of the specific products marketed resulted in wide confidence intervals on some of our estimates, and also precluded us from testing sociodemographic differences in viewing marketing across the various products.

5. Conclusion

This study identified, among YA never users of tobacco and cannabis, a high prevalence of seeing marketing for those products online and in TV/movies. Prevalence estimates varied between online advertisements and TV/movies by product type (e.g., combustible cigarettes vs. e-cigarettes) and sociodemographic characteristic. New and emerging tobacco products are marketed online, where YA are likely to see them, suggesting potential targets for regulatory action. Finally, priority populations for prevention of tobacco and cannabis use should include young women and LGB people.

CRedit authorship contribution statement

Evan A. Krueger: Conceptualization, Methodology, Writing – original draft. **Mariel S. Bello:** Writing – original draft. **Jennifer Unger:** Writing – review & editing, Project administration, Funding acquisition. **Tess Boley Cruz:** Writing – review & editing. **Jessica L. Barrington-Trimis:** Writing – review & editing, Project administration, Funding acquisition. **Jessica L. Braymiller:** Writing – review & editing. **H. Isabella Lanza:** Writing – review & editing. **Julia Cen Chen-Sankey:** Writing – review & editing. **Junhan Cho:** Methodology, Writing – review & editing. **Rob McConnell:** Writing – review & editing, Project administration, Funding acquisition. **Adam M. Leventhal:** Writing – original draft, Project administration, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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References

- Ayers, J.W., Caputi, T., Leas, E.C., 2019. The need for federal regulation of marijuana marketing. *JAMA* 321 (22), 2163–2164.
- Balbach, E.D., Gasior, R.J., Barbeau, E.M., 2003. RJ Reynolds’ targeting of African Americans: 1988–2000. *Am. J. Public Health* 93 (5), 822–827.
- Barger, B.T., Obedin-Maliver, J., Capriotti, M.R., Lunn, M.R., Flentje, A., 2021. Characterization of substance use among underrepresented sexual and gender minority participants in The Population Research in Identity and Disparities for Equality (PRIDE) Study. *Substance Abuse* 42 (1), 104–115.
- Biener, L., Siegel, M., 2000. Tobacco marketing and adolescent smoking: more support for a causal inference. *Am. J. Public Health* 90 (3), 407.
- US Census Bureau. American Community Survey 1-year estimates. 2019; <https://censusreporter.org/profiles/16000US0644000-los-angeles-ca/>. Accessed 01/13/2021.
- California Marijuana Laws. 2021; <https://potguide.com/california/marijuana-laws/>.
- Camenga, D., Gutierrez, K.M., Kong, G., Cavallo, D., Simon, P., Krishnan-Sarin, S., 2018. E-cigarette advertising exposure in e-cigarette naïve adolescents and subsequent e-cigarette use: a longitudinal cohort study. *Addict. Behav.* 81, 78–83.
- CDC. Youth and Tobacco Use. 2019; https://www.cdc.gov/tobacco/data_statistics/fact_sheets/youth_data/tobacco_use/index.htm.
- Cruz TB, McConnell R, Low BW, et al. Tobacco marketing and subsequent use of cigarettes, e-cigarettes, and hookah in adolescents. *Nicot. Tobacco Res.* 2019, 21(7): 926–932.
- Cruz, T., Rose, S., Lienemann, B., Byron, M.J., Meissner, H., Baezconde-Garbanati, L., Huang, L.-L., Carroll, D., Soto, C., Unger, J., 2019. Pro-tobacco marketing and anti-tobacco campaigns aimed at vulnerable populations: A review of the literature. *Tobacco Induc. Dis.* 17 <https://doi.org/10.18332/tid/111397>.
- Cummings, K.M., Morley, C.P., Horan, J.K., Steger, C., Leavell, N.-R., 2002. Marketing to America’s youth: evidence from corporate documents. *Tobacco Cont.* 11 (Supplement 1), i5–i17.
- Dai, H., 2017. Exposure to Advertisements and Marijuana Use Among US Adolescents. *Prevent. Chronic Dis.* 14.
- Dai, H., Hao, J., 2017. Electronic cigarette and marijuana use among youth in the United States. *Addict. Behav.* 66, 48–54.
- Dai, H., Leventhal, A.M., 2019. Prevalence of e-Cigarette Use Among Adults in the United States, 2014–2018. *JAMA* 322 (18), 1824–1827.
- Dalton, M.A., Sargent, J.D., Beach, M.L., Titus-Ernstoff, L., Gibson, J.J., Ahrens, M.B., Tickle, J.J., Heatherton, T.F., 2003. Effect of viewing smoking in movies on adolescent smoking initiation: a cohort study. *The Lancet* 362 (9380), 281–285.
- Dauphinee, A.L., Doxey, J.R., Schleicher, N.C., Fortmann, S.P., Henriksen, L., 2013. Racial differences in cigarette brand recognition and impact on youth smoking. *BMC Public Health* 13 (1), 170.
- Distefan, J.M., Pierce, J.P., Gilpin, E.A., 2004. Do favorite movie stars influence adolescent smoking initiation? *Am. J. Public Health* 94 (7), 1239–1244.
- Du, Y., Shih, M., Shah, M.D., Weber, M.D., Lightstone, A.S., 2019. Prevalence and sociodemographic disparities in ever E-cigarette use among adults in Los Angeles County. *Prevent. Med. Rep.* 15, 100904. <https://doi.org/10.1016/j.pmedr.2019.100904>.

- Emory, K., Buchtig, F.O., Trinidad, D.R., Vera, L., Emery, S.L., 2018. Lesbian, gay, bisexual, and transgender (LGBT) view it differently than non-LGBT: exposure to tobacco-related couponing, e-cigarette advertisements, and anti-tobacco messages on social and traditional media. *Nicotine Tob. Res.* 21 (4), 513–522.
- FDA. Achievements in Tobacco Regulation Over the Past Decade and Beyond. 2019; <https://www.fda.gov/news-events/fda-voices/achievements-tobacco-regulation-over-past-decade-and-beyond>. Accessed 05/01/2020.
- Fiala, S.C., Dilley, J.A., Firth, C.L., Maher, J.E., 2018. Exposure to marijuana marketing after legalization of retail sales: Oregonians' experiences, 2015–2016. *Am. J. Public Health* 108 (1), 120–127.
- Fiala, S.C., Dilley, J.A., Everson, E.M., Firth, C.L., Maher, J.E., 2020. Youth Exposure to Marijuana Advertising in Oregon's Legal Retail Marijuana Market. *Prevent. Chronic Dis.* 17.
- Gamarel, K.E., Mereish, E.H., Colby, S.M., Barnett, N.P., Hayes, K., Jackson, K.M., 2018. Sexual minority disparities in substance use willingness among youth. *Subst. Use Misuse* 53 (1), 170–175.
- GenIUSS Group, 2013. Gender-Related Measures Overview. The Williams Institute, UCLA School of Law.
- Hanewinkel, R., Isensee, B., Sargent, J.D., Morgenstern, M., 2011. Cigarette advertising and teen smoking initiation. *Pediatrics* 127 (2), e271–e278.
- Henriksen, L., Schleicher, N.C., Feighery, E.C., Fortmann, S.P., 2010. A longitudinal study of exposure to retail cigarette advertising and smoking initiation. *Pediatrics* 126 (2), 232–238.
- Higgins, S.T., Kurti, A.N., Palmer, M., Tidey, J.W., Cepeda-Benito, A., Cooper, M.R., Krebs, N.M., Baezconde-Garbanati, L., Hart, J.L., Stanton, C.A., 2019. A review of tobacco regulatory science research on vulnerable populations. *Prev. Med.* 128, 105709. <https://doi.org/10.1016/j.ypmed.2019.04.024>.
- Hunt, K., Sweeting, H., Sargent, J., Lewars, H., Young, R., West, P., 2011. Is there an association between seeing incidents of alcohol or drug use in films and young Scottish adults' own alcohol or drug use? A cross sectional study. *BMC Public Health* 11 (1), 259.
- Ilakkuvan, V., Johnson, A., Villanti, A.C., Evans, W.D., Turner, M., 2019. Patterns of social media use and their relationship to health risks among young adults. *J. Adolesc. Health* 64 (2), 158–164.
- Truth Initiative. Action needed: Tobacco in pop culture. 2019; <https://truthinitiative.org/research-resources/tobacco-pop-culture/action-needed-tobacco-pop-culture>. Accessed 05/01/2020.
- Jackler, R.K., Li, V.Y., Cardiff, R.A., Ramamurthi, D., 2019. Promotion of tobacco products on Facebook: policy versus practice. *Tobacco control* 28 (1), 67–73.
- Jackler, R.K., Chau, C., Getachew, B., et al., 2019. JUUL advertising over its first three years on the market. *SRITA White Paper*.
- Jones S. 2018. Cannabis and Product Placement Content Partnerships: The Mecca Of Regulation Free Advertising. *Hollywood Branded*.
- King, B.A., Gammon, D.G., Marynak, K.L., Rogers, T., 2018. Electronic cigarette sales in the United States, 2013–2017. *JAMA* 320 (13), 1379–1380.
- Leventhal, A.M., Strong, D.R., Kirkpatrick, M.G., Unger, J.B., Sussman, S., Riggs, N.R., Stone, M.D., Khoddam, R., Samet, J.M., Audrain-McGovern, J., 2015. Association of electronic cigarette use with initiation of combustible tobacco product smoking in early adolescence. *JAMA* 314 (7), 700. <https://doi.org/10.1001/jama.2015.8950>.
- Lienemann BA, Rose SW, Unger JB, et al. Tobacco advertisement liking, vulnerability factors, and tobacco use among young adults. *Nicot. Tobacco Res.* 2019;21(3):300–308.
- Lindblom, E.N., 2015. Effectively regulating e-cigarettes and their advertising-and the first amendment. *Food & Drug LJ.* 70, 55.
- Lovato, C., Watts, A., Stead, L.F., 2011. Impact of tobacco advertising and promotion on increasing adolescent smoking behaviours. *Cochrane Database System. Rev.* 10.
- Martin, B.A.S., 2003. The influence of gender on mood effects in advertising. *Psychol. Market.* 20 (3), 249–273.
- Mekemson, C., Glantz, S.A., 2002. How the tobacco industry built its relationship with Hollywood. *Tobacco control* 11 (Supplement 1), i81–i91.
- O'Brien, E.K., Hoffman, L., Navarro, M.A., Ganz, O., 2020. Social media use by leading US e-cigarette, cigarette, smokeless tobacco, cigar and hookah brands. *Tobacco Control*.
- Peters, E.N., Bae, D., Barrington-Trimis, J.L., Jarvis, B.P., Leventhal, A.M., 2018. Prevalence and sociodemographic correlates of adolescent use and polyuse of combustible, vaporized, and edible cannabis products. *JAMA Network Open.* 1 (5), e182765.
- Internet/Broadband Fact Sheet. 2019; <https://www.pewresearch.org/internet/fact-sheet/internet-broadband/>.
- Center PHL. Master Settlement Agreement. 2020, <https://publichealthlawcenter.org/topics/commercial-tobacco-control/commercial-tobacco-control-litigation/master-settlement-agreement>.
- Rising, J., Alexander, L., 2011. Marketing of menthol cigarettes and consumer perceptions. *Tobacco Induc. Dis.* 9 (S1), S2. <https://doi.org/10.1186/1617-9625-9-S1-S2>.
- Rup, J., Goodman, S., Hammond, D., 2020. Cannabis advertising, promotion and branding: differences in consumer exposure between 'legal' and 'illegal' markets in Canada and the US. *Prev. Med.* 133, 106013. <https://doi.org/10.1016/j.ypmed.2020.106013>.
- Sargent, J.D., Beach, M.L., Dalton, M.A., Mott, L.A., Tickle, J.J., Ahrens, M.B., Heatherton, T.F., 2001. Effect of seeing tobacco use in films on trying smoking among adolescents: cross sectional study. *BMJ* 323 (7326), 1394.
- Schulenberg J, Johnston L, O'Malley P, Bachman J, Miech R, Patrick M. 2019. Monitoring the Future national survey results on drug use, 1975-2018: Volume II, college students and adults ages 19-60.
- Soneji, S., Yang, J., Knutzen, K.E., Moran, M.B., Tan, A.S.L., Sargent, J., Choi, K., 2018. Online tobacco marketing and subsequent tobacco use. *Pediatrics* 141 (2), e20172927. <https://doi.org/10.1542/peds.2017-2927>.
- Tickle, J.J., Sargent, J.D., Dalton, M.A., Beach, M.L., Heatherton, T.F., 2001. Favourite movie stars, their tobacco use in contemporary movies, and its association with adolescent smoking. *Tobacco control* 10 (1), 16–22.
- Truth Initiative, 2020. Master Settlement Agreement. <https://truthinitiative.org/who-we-are/our-history/master-settlement-agreement>.
- Administration USDE. Drug Scheduling. <https://www.dea.gov/drug-scheduling>.
- Wagoner, K.G., Reboussin, D.M., King, J.L., Orlan, E., Cornacchione Ross, J., Sutfin, E.L., 2019. Who is exposed to e-cigarette advertising and where? Differences between adolescents, young adults and older adults. *Int. J. Environ. Res. Public Health* 16 (14), 2533.
- Walsh, J., 2013. Q&A: Legal Marijuana in Colorado and Washington. *Brooking Institution*.
- Wellman, R.J., Sugarman, D.B., DiFranza, J.R., Winickoff, J.P., 2006. The extent to which tobacco marketing and tobacco use in films contribute to children's use of tobacco: a meta-analysis. *Arch. Pediatr. Adolesc. Med.* 160 (12), 1285–1296.
- Willett, J.G., Bennett, M., Hair, E.C., et al., 2019. Recognition, use and perceptions of JUUL among youth and young adults. *Tobacco Control* 28 (1), 115–116.
- Zhang, X., Vuong, T.D., Andersen-Rodgers, E., Roeseler, A., 2018. Evaluation of California's "Tobacco 21" law. *Tobacco Control* 27 (6), 656–662.