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Exposure to cannabis marketing in social and traditional media and past-year use among adolescents in states with legal retail cannabis

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Abstract

Purpose.—To examine adolescents’ self-reported exposure to cannabis marketing in states with legalized cannabis and its association with past-year cannabis use.

Methods.—We conducted a cross-sectional, online panel survey of 469 adolescents age 15–19 years residing in four states with legal retail cannabis for adult use. Adolescents self-reported exposure to cannabis marketing on social or traditional media (i.e. outdoor or print) and past-year cannabis use. Logistic regression generated estimated odds of youths’ past-year cannabis use by marketing exposure after adjusting for demographic factors and cannabis-related social norms.

Results.—Exposure to cannabis marketing on Facebook, Twitter, and Instagram was associated with increased odds of past-year cannabis use of 96% (95% CI: 15%–234%), 88% (95% CI: 11%–219%), and 129% (95% CI: 32%–287%), respectively. Odds of past-year cannabis use increased by 48% (95% CI: 16%–87%) with each additional social media platform where adolescents reported exposure.

Conclusion.—Despite restrictions that prohibit cannabis advertising on social media, adolescents are exposed to cannabis marketing via social media, and this exposure is associated with recent cannabis use. States should consider further regulation of cannabis marketing on social media.

Keywords

Adolescents; cannabis; social media; marketing

Implications and Contribution

Adolescents in states with legal retail cannabis are exposed to cannabis marketing on social media. Exposure to such marketing via Instagram, Facebook and Twitter was associated with past-year cannabis use. Additional research is warranted and policymakers should consider further regulation of cannabis marketing on social media.

Cannabis (marijuana) use is common among adolescents in the United States (U.S.)[1]. Youth who initiate cannabis use at earlier ages are at higher risk of developing cannabis use disorders or cannabis dependence compared to those who start later[2, 3]. Regular cannabis use in adolescence is associated with decreased cognitive function, poor academic performance, and other drug use[4, 5]. Adolescents who drive after using cannabis may be at increased risk of motor vehicle crash involvement[6].

As of August 2019, eleven U.S. states have legalized cannabis for general (i.e. recreational) use by adults over age 21 years[7]. In most of these states, drug policy reform organizations successfully led ballot initiatives to legalize, regulate, and tax cannabis like alcohol[8]. From a public health perspective, using alcohol as a regulatory model is concerning[9] because underage drinking remains common and alcohol continues to play a substantial role in injury, deaths, and other adverse health consequences among adolescents[10, 11]. Nonetheless, retail cannabis shops are open in seven states, and the U.S. cannabis market was valued at \$10.4 billion in 2018 with expectation of continued growth[12]. One aspect of this new legal cannabis marketplace that is relatively understudied is exposure to cannabis marketing.

Marketing has been defined as “any commercial communication or other activity, including advertising, promotion, and sponsorship, that is designed to increase the recognition, appeal and/or consumption” of the product being marketed[13]. This includes both direct advertising (e.g. paid messages) and indirect promotions (e.g. events, giveaways, discounts, etc.). Yet because of cannabis’ status as a Schedule 1 substance under the federal Controlled Substances Act, many marketing activities used for other products or substances are banned, particularly if they cross state lines. The same is true of direct advertising for cannabis on most major social media platforms [14]. However, cannabis businesses may establish a social media profile to represent their brand and create posts that are seen by followers of that page. If these business profiles post about cannabis, this content may not fall under the platforms’ restrictions on direct advertising. Thus, adolescents may access and potentially engage with cannabis companies via profiles established by these businesses.[15]

Relatively little is known about the relationship between adolescents’ exposure to cannabis marketing and cannabis use, but decades of research on alcohol and tobacco—other legal substances with abuse potential—show strong correlations between youth exposure to marketing and both earlier initiation and higher consumption among those already using[16, 17]. This suggests that exposure to cannabis marketing could have a similar relationship with cannabis use behaviors.

Exposure to cannabis-promoting content on social media is of particular concern because nearly all teens use some form of social media (e.g., Instagram, Facebook, Twitter), and 45%

report being online “almost constantly”[18]. Data from the 2014 and 2015 iterations of a nationally representative survey of high school students showed that just over half of adolescents reported exposure to cannabis advertising on the internet, and this exposure was associated with greater odds of recent cannabis use and more frequent use[19]. However, this study did not differentiate between cannabis advertising on social media or via other internet sources. Longitudinal data from California—where medical marijuana has been legal since 1996—showed adolescents’ exposure to medical cannabis advertising (in billboards, magazines, or somewhere else) has increased over time [20]. Adolescents with higher than average exposure reported more frequent cannabis use, stronger intentions to use cannabis in the future, more positive expectancies about cannabis use, and more negative consequences from cannabis use [20]. Several studies have documented that adults report exposure to cannabis marketing online, including on social media[21–23], but the extent to which that is true for adolescents is unknown.

Emerging research among adolescents supports applying constructs from the Theory of Normative Social Behavior (TNSB) to help explain the pathway between exposure to marketing and cannabis use behavior. Pro-cannabis injunctive norms (i.e., perceptions of others’ approval of a behavior) have been found to be predictive of cannabis use in university students [24]. TNSB suggests that behaviors, including substance use behaviors, are shaped by injunctive norms[25, 26] and outcome expectations (i.e., beliefs about the consequences of a behavior)[27]. Exposure to cannabis promotions via social media could influence adolescent cannabis use by helping to shape injunctive norms suggesting high levels of peer approval of cannabis use and/or by creating or reinforcing positive outcome expectations. Exposure to cannabis-promoting content on social media may be particularly influential on adolescent behavior if that content is liked or shared by peers.

States differ in their restrictions on cannabis marketing. With respect to youth, states prescribe restrictions on cannabis marketing placement and content. In terms of placement, Colorado established its cannabis marketing policies based on the alcohol industry’s voluntary code, which requires companies not to advertise in outlets (i.e. television, radio, print, and the Internet) in which more than 30% of the audience can be “reasonably” expected to be under 21 years of age. A similar standard has been transferred, with different degrees of specification, to seven other states with legal retail cannabis markets.

This standard as applied to alcohol has been the subject of substantial criticism from both policy makers and alcohol researchers [28, 29] Youth who are most at risk of initiating alcohol use are between the ages of 12 and 20; this group comprises closer to 15% of the U.S. population [28]. A 30% standard allows this group to be targeted much more heavily than their presence in the population would warrant, and studies of youth exposure to alcohol marketing have consistently documented this disproportionate exposure [30, 31]. It is concerning that this standard is, nonetheless, being applied in the context of cannabis legalization. Cannabis marketing regulations also include minimum distance standards for places frequented by children (e.g., schools). In addition, some states prohibit cannabis marketing content that targets youth; however, experience with alcohol advertising self-regulatory codes has shown that such content standards are ineffective at shielding youth from content attractive to them [30].

This study sought to address the gap in knowledge about the extent to which adolescents are exposed to cannabis marketing via both social and traditional media platforms. Using cross-sectional data, we examined whether cannabis marketing exposure was associated with past year cannabis use after controlling for known risk factors, such as older age, male gender [1, 32], pro-cannabis injunctive norms, and positive expectancies [33]. In particular, we investigated exposure to cannabis advertising or promotions via three popular social media platforms (Facebook, Twitter, and Instagram) as well as two traditional platforms (outdoor billboards and print media) in four states with legalized retail cannabis. In addition, we explored the relationship between cannabis use and exposure to cannabis marketing via multiple platforms.

Methods

In February 2018, we conducted a survey using an online panel (Qualtrics, Provo, UT) of English-speaking adolescents age 15–19 years residing in four states with legal non-medical cannabis (California, Colorado, Nevada, and Washington). All sampled states had implemented medical or general adult use cannabis sales for at least one year prior to our data collection.

Qualtrics recruits panelists with online advertisements (e.g. on social media or in apps), inviting survey participation as a way to earn credit towards rewards such as gift cards, in-app purchases, or airline miles. A background check is conducted to verify identity before the participant becomes part of a panel and eligible for recruitment. Surveys deployed via Qualtrics panels typically demonstrate demographic characteristics that fall within a 10% range of the values observed in the U.S. population [34].

Qualtrics sent survey invitations to existing panel members who were parents of youth ages 15 to 17 years and to adults age 18 or 19 years. The sample was designed to be balanced between younger (15–17 years) and older (18–19 years) adolescents. A simple recruitment message was emailed to potentially eligible individuals notifying them of a survey opportunity, describing the estimated survey length (15 minutes), and informing them that up to approximately \$20 in e-rewards credit could be obtained in return for participation. All adult participants provided informed consent, and minor participants provided informed assent and their legally authorized guardians provided parental consent. Minor participants were instructed to complete the survey independently in a private location. Forty-six percent of individuals who initiated the survey screening items did not consent to participate or were outside the target age range. The Institutional Review Board at the University of Wisconsin-Madison approved this study.

Measures

Demographics.—We categorized age into middle adolescence (age 15–17 years) and older adolescence (age 18–19 years). Gender was measured using 3 categories: female, male, and other. We combined separate survey questions on race and ethnicity into one categorical variable: White/Caucasian, Black/African American, Hispanic/Latino, and other. Parent education was measured using five categories: less than high school diploma, high school diploma, some college or associate degree, bachelor's degree, or advanced degree.

Social Media Use.—Participants’ social media use patterns were ascertained by asking “Which of the following social media platforms do you use?” with a multiple response option that allowed participants to indicate whether or not they use Facebook, Instagram, Twitter, or other platforms.

Cannabis Use.—Lifetime cannabis use was ascertained. The survey provided the term marijuana as well as cannabis at first mention of the drug and was pilot tested with adolescents to ensure comprehension. Adolescents who reported any lifetime cannabis use were asked about past year use with the question: “What types of cannabis have you used in the past 12 months?” Youth could select more than one response from choices including cannabis (plant), concentrates/extracts, edibles, other, and “I have not used cannabis in the past 12 months”. We recoded this item so “I have not used cannabis in the past 12 months” and lifetime non-users were coded as having no past year cannabis use (0) and all other options were coded as yes (1).

Exposure to cannabis marketing.—Participants self-reported their frequency of exposure to cannabis marketing on three social media platforms (Facebook, Twitter, and Instagram) and via two traditional platforms (newspapers/magazines and outdoor). Questions were adapted from the National Youth Tobacco Survey (NYTS)[35] and used the following structure: “When you are using [PLATFORM], how often do you see ads or promotions for cannabis or related products?” Response options were coded on a 5-point Likert scale (never, rarely, sometimes, most of the time, always) and respondents had the option to report they do not use each particular platform. We recoded these variables into a binary (yes/no) format where rarely, sometimes, most of the time, and always were coded as yes (1). Never and I don’t use [PLATFORM] were coded as no (0).

For traditional media platforms, we asked participants to report exposure to outdoor advertising with the question “in the past 30 days, how often did you see any ads or promotions for cannabis or related products that were outdoors on a billboard or could be seen from outside a store?” We also asked “When you read newspapers or magazines (online or in print), how often do you see ads or promotions for cannabis or related products?” The same 5-point Likert scale response (i.e. never to always) and approach to dichotomization (yes/no) as described above was used for these items. These items were also adapted from the NYTS[36].

We calculated a count of the number of platforms with cannabis marketing exposure by summing the respective binary variables. We did this three times, counting exposure across social media platforms (i.e., Facebook, Twitter, and Instagram), traditional media platforms (i.e., outdoor advertising and newspapers/magazines), and all platforms.

Theory of Normative Social Behavior.

Injunctive norms. The injunctive norms questions used a five-point Likert scale for participants to rate how much they agreed (strongly agree to strongly disagree) with statements on the appropriateness of people their age consuming cannabis every weekend. Youth first provided their own perception of appropriateness and then gave their perception

of society's perceived appropriateness in general. We averaged these items to form a measure of the extent to which youth felt cannabis use was acceptable.

Outcome expectations.: The outcome expectations scale contained six items ascertaining the participants' perception of what would happen after someone used cannabis. There were three positive items (e.g., cannabis helps you relax and feel less tense) and three negative items (e.g., cannabis makes it harder to think and do things). We reverse scored the negative items and calculated an average. The resulting outcome expectations variable can be interpreted as the extent to which youth expected more positive or fewer negative consequences from cannabis use.

Analyses

Exploratory data analysis included frequencies, chi-squared tests of association, and t-tests assuming unequal variance. We also centered the outcome expectations variable. Because cannabis use and motivations for use may differ by gender, we examined this by including a gender* outcome expectations interaction term. We used logistic regression with robust standard errors to determine the association between cannabis marketing exposure and past year cannabis use after adjusting for demographics, injunctive norms, outcome expectations, and group identity. Model specification was assessed using specification link tests, and model fit was assessed using Hosmer Lemeshow's Goodness of Fit test. All models had appropriate specifications and fits. We used standardized residuals, deviance, and leverage to identify potential outliers and influential points. In the end, we determined that no data points had undue influence, and all observations remained in the analysis.

Results

The analytic sample included 469 participants (70% female, 26% male, and 4% other) after dropping 28 youth with missing data on cannabis use or demographic factors (Table 1). A majority of participants (61%) were from California with 13.6% from Colorado, 7.9% from Nevada and 17.9% from Washington State. All adolescents in the sample reported using at least one social media platform.

Most adolescents (93.6%) in the sample reported some form of exposure to cannabis marketing (Table 2). A majority of adolescents reported seeing cannabis marketing on at least one social media platform, with a higher proportion of past-year cannabis users reporting exposure (89.6%) than non-users (74.0%) ($p < 0.001$). Of the three social media platforms examined, the proportion of adolescents reporting exposure to marketing via Facebook was highest, and more past-year cannabis users reported exposure on Facebook (72.4%) than those who did not use cannabis in the past year (52.5%, $p < 0.001$). Of the traditional platforms, exposure to outdoor advertising (e.g., billboards) was more common (72.9%) than exposure via newspapers or magazines (43.1%). A higher proportion of cannabis users (79.9%) reported exposure to outdoor advertising compared to non-users (70.1%) ($p = 0.033$). Cannabis marketing exposure on Instagram was higher for Blacks compared to other racial/ethnic groups and on Facebook and Twitter for older adolescents vs. younger adolescents, but no other differences in exposure were observed by demographic variables (Supplemental Table S1).

When controlling for demographic factors, injunctive norms about cannabis use, cannabis outcome expectancies, and the interaction between gender and cannabis outcome expectancies, we found that past year cannabis use was positively associated with perceived exposure to cannabis marketing. The increase was highest for Instagram (OR=2.29; 95% CI: 1.32–3.97), followed by Facebook (OR=1.96; 95% CI: 1.15–3.34), and Twitter (OR=1.88; 95% CI: 1.11 – 3.19) (Table 3). There were no associations between exposure to cannabis advertising outdoors (e.g. billboards) or via newspapers/magazines and past year cannabis use (Supplemental Table S2).

When looking at cumulative exposure across the five platforms, there was a 26% (CI: 09% –45%) increase in the odds of past year use associated with each additional media platform on which adolescents were exposed to cannabis marketing, controlling for possible confounders (Table 4). Among the three social media platforms, there was a 48% (CI:16% –87%) increase in the adjusted odds of past year cannabis use associated with each additional platform on which adolescents viewed cannabis marketing.

Discussion

In this sample of adolescents from four states with retail cannabis, nearly all adolescents reported perceived exposure to cannabis marketing. This is similar to findings from California youth [20]. In a novel contribution to the literature, we found that the prevalence of reported exposure to cannabis marketing on social media was high, despite the fact that direct cannabis advertising is prohibited on those platforms. Over three-quarters of youth reported being exposed to cannabis marketing via social media, a proportion 5% higher than those who reported exposure via outdoor advertising. Outdoor advertising offers minimal control over who views it; teens and young children who are driven by their parents on a public highway with a cannabis billboard will encounter this advertising just as often as adults who travel the same path. It is concerning that teens may be seeing even higher levels of cannabis marketing on social media where it can be highly interactive and influential and where, theoretically, there is greater potential for control over viewership.

Our study found few differences in exposure by demographic factors, but it is notable that Black youth reported a disproportionately high level of cannabis marketing exposure on Instagram. We observed higher odds of past year cannabis use among youth who reported exposure to cannabis marketing on social media, even after controlling for demographics and normative factors that influence cannabis use. This is in line with research on alcohol and tobacco showing that youth with greater exposure to marketing are more likely to use or increase their use of these products, particularly when that exposure involves participation in the marketing [37], which is precisely what social media facilitates through features such as liking and sharing.

The strength of the association with past-year cannabis use was highest for exposure to cannabis marketing on Instagram, followed by Facebook and then Twitter. This may be reflective of the fact that Instagram has grown in popularity as a social media platform among adolescents[38]. Each additional social media platform through which adolescents

were exposed to cannabis marketing was associated with increased odds of past-year cannabis use.

Of the states included in this study, Colorado, Nevada, and California specifically prohibit cannabis retailers from marketing on media platforms where more than about 30% of the audience is expected to be under 21 years of age. Washington State advises cannabis businesses to “use social media with caution and to be mindful not to appeal to, or solicit, viewers under the age of 21. If possible, please restrict views to adults age 21 and older” [39]. Despite these guidelines and restrictions, and despite the federal prohibition of cannabis use, our data demonstrate that cannabis promotions are currently reaching most adolescents.

Given the potential negative consequences of adolescent cannabis use and social media’s possible role in this use, states should consider substantial restrictions on marketing. In line with the cannabis policy framework laid out by the Canadian Centre for Addiction and Mental Health, we suggest states consider banning all marketing of cannabis products [40]. This would be representative of a public health approach that draws upon the evidence in the related area of tobacco regulation; prevalence of smoking among adolescents has generally decreased in locations that banned tobacco marketing[41]. It is also what has been recommended by the Pan American Health Organization for alcohol marketing if such a ban is constitutionally feasible[13]; because cannabis is still illegal at the federal level, states have more leeway to consider a full ban on cannabis marketing than they do for alcohol marketing.

If a full ban cannot be enacted, there are several other actions that states could consider: (1) reducing the audience composition threshold for the proportion of underage individuals in venues where cannabis is advertised, directly or indirectly, from 30% to 10–15%, to be in line with the proportion of youth age 12–20 years in the general population[28]; (2) requiring cannabis marketers to supply on a regular basis marketing expenditure data, including amounts spent on advertising, price discounting and incentives, promotional allowances, payments to retailers and wholesalers, and contributions to elected officials [42], as well as data on where ads are being placed and best available demographic information about audiences being reached [31, 43]; (3) establishing well-researched and well-funded counter-marketing campaigns that deliver public health messages; (4) removing the tax deductibility of cannabis advertising and marketing expenditures at the state level to effectively increase the costs of these activities; and (5) funding research to evaluate the impacts of different cannabis marketing policies on adolescent cannabis use, problematic use, and dependence.

There are additional challenges to consider when trying to prevent youth exposure to cannabis marketing. Although paid cannabis advertisements purchased and placed through the social media platforms’ advertising portals are prohibited, unpaid promotions are exempt from these policies. The policies also do not keep individuals from seeking out such content via business pages, or encountering it when shared by others in their social network. It will be important for future studies to document and understand the impact of passive exposure to cannabis promotions versus cannabis content-seeking behavior, either on social media

sites or on cannabis-specific websites (e.g. Weedmaps, Leafly.) Additional research is also needed into whether algorithms used by social media platforms are targeting cannabis-related content to underage individuals or specific demographic groups.

Limitations

There are several limitations to this study. First, we examined cannabis marketing exposure through three primary social media platforms, but there are others (e.g. SnapChat, YouTube) and cannabis-specific platforms where cannabis marketing exposure may occur.

Second, the cross-sectional design does not permit us to draw conclusions about directionality of the observed associations or conclude that the associations are causal. Indeed, adolescents who use cannabis may also seek out cannabis-promoting content. Evidence of this inverse relationship between cannabis use and increased exposure to marketing was found in a longitudinal study demonstrating that California youth reporting higher levels of cannabis use at one time point also reported more medical cannabis advertising exposure one year later.[20, 44]

Third, there are some potential sources of bias. Response bias could be a threat if lower-income individuals were more likely to take the survey compared to those with higher incomes, given that an incentive was offered. We did not ascertain household income, so we could not assess the extent to which this may have affected these data. Social desirability bias can also be a threat in self-reported data like these if subjects underreport illegal behaviors. We believe this does not substantially threaten validity of this study because the prevalence of past year cannabis use in our sample was similar to national estimates obtained via traditional survey methods.[1] Recall bias could also be an issue if cannabis-using youth had different recall of marketing exposure than non-users. Additionally, misclassification bias could be a concern if youth did not accurately discern between formal promotions from cannabis businesses and user-generated content, which could result in an overestimation of exposure to cannabis promotions.

Fourth, our power to conduct stratified analyses and detect differences within subgroups was limited by the sample size.

Lastly, the non-probability sample was not designed for representativeness of adolescents in the U.S. or of the states with legal retail cannabis. Females were over-represented in the sample, but our regression analyses controlled for gender which helps to mitigate any bias from this imbalance. Our sample was also not balanced across the four included states; adolescents from California comprised over half of the sample. This is likely due to California having a much larger population compared to the other three states. Given this non-probability design, we did not seek to make state-level estimates or comparisons across states. Despite the potential limits to generalizability, high-quality online panel vendors can provide researchers with quick and cost-efficient access to survey respondents that resemble the general population [45] and this was especially valuable in the present study where the policy environment is rapidly changing and there is a need for measurement to inform ongoing research and policy discussions.

Conclusion

Although direct marketing of cannabis on social media remains illegal, youth are exposed to cannabis products and content via promotional pages, and such exposure is associated with cannabis use. Current policies to help prevent exposure to cannabis marketing online are not effective. While larger, longitudinal studies about exposure to cannabis marketing on social media and onset of adolescent cannabis use are needed, states should consider adopting the most restrictive cannabis marketing policies feasible, combined with an accountability and enforcement infrastructure that will help protect the current generation of adolescents.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Sample demographic and background characteristics

	Used cannabis in past year				total		p-value
	No (n=335)		Yes(n=134)		(n=469)		
	n	%	n	%	n	%	
Age							0.050
15 to 16 years	176	52.5	57	42.5	233	49.7	
17 to 19 years	159	47.5	77	57.5	236	50.3	
Gender							0.721
Female	232	69.3	97	72.4	329	70.1	
Male	92	27.5	32	23.9	124	26.4	
Other	11	3.3	5	3.7	16	3.4	
Race/Ethnicity							0.602
White	118	35.2	52	38.8	170	36.2	
Black	21	6.3	10	7.5	31	6.6	
Hispanic/Latino	132	39.4	53	39.6	185	39.4	
Other	64	19.1	19	14.2	83	17.7	
Parent's Highest Grade Completed							0.176
Less than HS	71	21.2	23	17.2	94	20.0	
HSorGED	117	34.9	59	44.0	176	37.5	
Some College or Higher	147	43.9	52	38.8	199	42.4	
State of Residential Address							0.143
California	210	62.7	74	55.2	284	60.6	
Colorado	47	14.0	17	12.7	64	13.6	
Nevada	21	6.3	16	11.9	37	7.9	
Washington	57	17.0	27	20.1	84	17.9	
Media use habits							
Use of Facebook	241	71.9	111	82.8	352	75.1	0.014
Use of Twitter	186	55.5	84	62.7	270	57.6	0.156
Use of Instagram	278	83.0	123	91.8	401	85.5	0.014
Frequency of Social Media Use							0.543
Never	1	0.3	0	0.0	1	0.2	
Monthly	8	2.4	1	0.7	9	1.9	
A few times a month	2	0.6	1	0.7	3	0.6	
Weekly	3	0.9	1	0.7	4	0.9	
A few times a week	25	7.5	5	3.7	30	6.4	
Once a day	29	8.7	9	6.7	38	8.1	
More than once a day	267	79.7	117	87.3	384	81.9	
Daily Social Media Use (n= 441 daily users)							0.342
Less than 30 min per day	126	41.2	58	43.0	184	41.7	
30–60 min per day	79	25.8	37	27.4	116	26.3	
1–2 hours per day	54	17.6	19	14.1	73	16.6	

	Used cannabis in past year				total		
	No (n=335)		Yes(n=134)		(n=469)		p-value
	n	%	n	%	n	%	
2-4 hours per day	27	8.8	10	7.4	37	8.4	
4+ hours per day	8	2.6	2	1.5	10	2.3	

AOR adjusted odds ratio; CI confidence interval; GED general educational development

P-value from chi-square tests.

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Table 2.

Prevalence of exposure to cannabis marketing among adolescents, by platform

	Used cannabis in past year			total		p-value
	No(n=335)	Yes(n=134)	n=469	n	%	
Exposure to cannabis advertising/promotions via:						
Any platform	309	130	439	93.6	0.056	
Any social media platform	248	120	368	78.5	<0.001	
Facebook	176	97	273	58.2	<0.001	
Twitter	122	68	190	40.5	0.004	
Instagram	196	102	298	63.5	<0.001	
Newspapers/magazines	137	65	202	43.1	0.133	
Outdoors (e.g. billboards)	235	107	342	72.9	0.033	

Note. P-value from chi-square tests.

Table 3. Multivariable associations between exposure to cannabis marketing on social media and past year cannabis use

	Facebook			Twitter			Instagram		
	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value
Exposure to promotions on Facebook									
No (reference group)									
Yes	1.96	(1.15 – 3.34)	0.013						
Exposure to promotions on Twitter									
No (reference group)									
Yes				1.88	(1.11 – 3.19)	0.018			
Exposure to promotions on Instagram									
No (reference group)									
Yes							2.29	(1.32 – 3.97)	0.003
Age category									
mid-adolescence (reference group)									
older adolescence	0.74	(0.42 – 1.30)	0.298	0.74	(0.42 – 1.31)	0.305	0.84	(0.48 – 1.48)	0.553
Gender									
female (reference group)									
male	1.30	(0.70 – 2.41)	0.401	1.32	(0.71 – 2.47)	0.383	1.35	(0.73 – 2.52)	0.343
other	1.26	(0.41 – 3.82)	0.686	1.51	(0.44 – 5.10)	0.511	1.29	(0.39 – 4.34)	0.678
Race/ethnicity									
White (reference group)									
Black	1.25	(0.32 – 4.92)	0.75	1.22	(0.30 – 4.93)	0.782	1.17	(0.29 – 4.69)	0.832
Hispanic/Latino	0.87	(0.50 – 1.54)	0.641	0.86	(0.49 – 1.51)	0.599	0.84	(0.47 – 1.49)	0.524
Other	0.55	(0.26 – 1.17)	0.120	0.53	(0.25 – 1.13)	0.102	0.54	(0.25 – 1.16)	0.115
Parent education									
Less than high school (reference group)									
HS or GED	2.26	(1.13 – 4.54)	0.021	2.19	(1.10 – 4.32)	0.025	2.33	(1.17 – 4.63)	0.016
Completed some college or more	1.73	(0.85 – 3.52)	0.131	1.61	(0.81 – 3.23)	0.177	1.77	(0.87 – 3.58)	0.113
Theory of normative social behavior injunctive norms	1.74	(1.40 – 2.17)	<0.001	1.71	(1.37 – 2.13)	<0.001	1.73	(1.38 – 2.16)	<0.001

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	Facebook		Twitter		Instagram	
	OR	95% CI	OR	95% CI	OR	95% CI
outcome expectancies score	63.83	(14.31 – 284.82)	76.80	(15.38 – 383.51)	63.34	(14.65 – 273.86)
gender X outcome expectancies	0.24	(0.11 – 0.56)	0.23	(0.09 – 0.57)	0.25	(0.11 – 0.58)
		p-value		p-value		p-value
		<0.001		<0.001		<0.001
		0.001		0.001		0.001

AOR adjusted odds ratio; CI confidence interval; GED general educational development

Bold = statistically significant at alpha=0.05

Table 4.

Cumulative exposure to cannabis marketing and past year cannabis use

	All platforms		Social media platforms		Traditional media platforms	
	OR	95% CI	OR	95% CI	OR	95% CI
No. of platforms*	1.26	(1.09 – 1.45)				
No. of social media platforms*			1.48	(1.16 – 1.87)		
No. of traditional media platforms*					1.23	(0.98 – 1.54)
Age category						
mid-adolescence	0.75	(0.43 – 1.33)	0.76	(0.43 – 1.33)	0.78	(0.45 – 1.37)
older adolescence						
gender						
female (reference group)						0.391
male	1.29	(0.69 – 2.40)	1.35	(0.72 – 2.52)	1.26	(0.68 – 2.33)
other	1.38	(0.40 – 4.77)	1.44	(0.44 – 4.68)	1.30	(0.38 – 4.47)
Race/ethnicity						
White (reference group)						
Black	1.19	(0.28 – 5.10)	1.09	(0.26 – 4.61)	1.35	(0.34 – 5.30)
Hispanic/Latino	0.88	(0.50 – 1.56)	0.87	(0.49 – 1.54)	0.86	(0.49 – 1.53)
Other	0.54	(0.26 – 1.14)	0.53	(0.24 – 1.13)	0.55	(0.26 – 1.16)
Parent education						
Less than high school (reference group)						
HSorGED	2.35	(1.17 – 4.73)	2.29	(1.14 – 4.58)	2.3	(1.15 – 4.58)
Completed some college or more	1.71	(0.84 – 3.47)	1.71	(0.84 – 3.48)	1.66	(0.82 – 3.35)
Theory of normative social behavior						
injunctive norms	1.73	(1.38 – 2.16)	1.70	(1.36 – 2.11)	1.77	(1.41 – 2.22)
outcome expectancies score	67.8	(14.11 – 325.84)	76.88	(16.33 – 362.03)	57.83	(12.61 – 265.14)
gender X outcome expectancies	0.24	(0.01 – 0.09)	0.22	(0.09 – 0.53)	0.26	(0.11 – 0.63)

* Odds ratio represents increase in odds of past year cannabis use associated with a 1 unit increase in the number of platforms via which the participant observed cannabis advertising or promotions. Five platforms were measured: 3 social media platforms (Facebook, Twitter, and Instagram) and 2 traditional media platforms (outdoor and newspaper/magazines).

AOR adjusted odds ratio; CI confidence interval; GED general educational development

Bold = statistically significant at alpha=0.05