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ASSOCIATIONS BETWEEN EXPOSURE TO CANNABIS ADVERTISEMENTS AND FREQUENCY AND SEVERITY OF CANNABIS USE IN OLDER ADOLESCENTS

PREDICTIVE MODELING

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Summary

Youth and Cannabis Advertisements

In a national survey study with 20 legal cannabis states among youth (ages 16-20), we examined whether greater scores on a cannabis advertisement exposure index varied between types of jurisdiction (medical-only vs. nonmedical states) was associated with greater odds of past-week cannabis use prevalence and cannabis use disorder (CUD). No associations were found between the cannabis advertisement exposure index and past-week use status in youth for either jurisdiction. However, CPPC found that in medical-only states (not adult use states), greater advertisement exposure was associated with greater odds of CUD even when controlling for other relevant variables. These findings were strengthened after a Z-score test was used to find that more frequent exposure to cannabis advertisements was more strongly correlated to problematic cannabis use in medical-only states ($r=.38$, $p < .01$) than adult use states ($r=-.002$, $p=.98$). These findings suggest that exposure to cannabis advertisements may present greater risk for CUD in states with medical-only cannabis laws, and suggest that further research is needed to examine the impacts of cannabis advertisements on youth across fully legal, medical, and illegal states.

Key Highlights



AD EXPOSURE

Youth ages 16-20 years old show similar cannabis ad exposure index scores in nonmedical use states than in medical-only states, which equates to an average of at least 4 advertisements per month among those using cannabis in the past year.



PAST MONTH USE

More frequent exposure to cannabis advertisements in youth are **NOT** associated with greater likelihood to use cannabis in the week in both medical-only and nonmedical use states.



CUD RATES

More frequent exposure to cannabis advertisements in youth **IS** associated with greater likelihood of screening positive for cannabis use disorder (CUD) in medical-only states, but **NOT** in adult use states.

Future Directions

Results from future research are needed to replicate these findings, and could provide targeted insights regarding restrictions to the frequency, modality, and jurisdiction in which cannabis advertisements are placed.

Associations Between Exposure to Cannabis Advertisements and Frequency and Severity of Cannabis Use in Older Adolescents

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Summary: In this national survey study with 20 legal cannabis states, we compared frequency of cannabis advertisement exposure among youth (ages 16-20; n=340) in medical cannabis states compared to nonmedical use states, and examined whether greater advertisement exposure in each type of jurisdiction was associated with greater odds of past-month cannabis use prevalence and cannabis use disorder (CUD). We found no associations with cannabis advertisement exposure and weekly or more cannabis use prevalence, but in medical-only states (not nonmedical use states), we found that greater advertisement exposure was associated with greater odds of CUD even when controlling for other relevant anxiety, depression, age of first cannabis use, and sociodemographic variables. A follow-up analysis revealed that greater advertisement exposure was significantly associated with continuous measures of cannabis use frequency and problematic cannabis use, however, there was a stronger correlation between advertisement exposure and problematic use in medical-only states ($r=.40$, $p<.01$) relative to nonmedical states ($r= .004$; $z = -3.78$, $p<.001$). These findings suggest that exposure to cannabis advertisements may present greater risk for CUD in states that only have medical cannabis laws, and highlights the importance of further research which attempts to isolate the impacts of cannabis advertisements on youth across legal and illegal jurisdictions using longitudinal designs.

Key Highlights

- On average, youth (16-20 years old) who used cannabis in the past year in legal cannabis states were exposed to an average of at least 4 cannabis advertisements per month.
- More frequent exposure to cannabis advertisements in youth are NOT associated with greater likelihood to engage in at least weekly cannabis use in either medical-only or nonmedical use states.
- More frequent exposure to cannabis advertisements in youth IS associated with greater likelihood of meeting screening criteria for cannabis use disorder (CUD) in medical-only states, but NOT in nonmedical use states.

Abstract

Rationale: Little is known about the prevalence and effects of youth exposure to cannabis advertisements in legal cannabis states on cannabis use frequency and problematic cannabis use despite growing evidence of harms associated with youth cannabis use.

Methods: An online sample of 340 youth (16-20 years old) recruited from 10 medical-only states and 9 nonmedical use states using the Regulatory Determinants of Cannabis Outcomes Survey (RDCOS). Items included demographic variables (age, gender, education, family income), number of cannabis use days in the past month was assessed to derive past month use status (no/yes), and the Cannabis Use Disorder Identification Task-Short Form (CUDIT-SF) was used to assess CUD status. Regression analyses modeled the association between cannabis advertisement exposure and past-month cannabis use status, CUD status, cannabis use frequency, and problematic cannabis use for those in medical-only states (4 models) and those in nonmedical use states (4 models) controlling for demographic variables, total grams of cannabis used in the past month, and depression and anxiety symptoms.

Results: When controlling for education, gender, family income, anxiety, depression, age of first cannabis use, and age, we found that nonmedical use and medical-only states did not show a significant association between cannabis advertisements exposure and past month use prevalence ($p > .27$). For nonmedical use states, there was not a significant association between cannabis advertisement exposure and CUD status ($p = .64$), however, in medical-only states cannabis advertisement exposure was predictive of increased risk for meeting criteria for CUD ($p < .01$), with each additional advertisement increasing the risk of having CUD by about 18% ($OR = 1.18$, $p < .01$). The result of Z-score test ($Z = -3.78$, $p < .001$) showed that there was a stronger relationship between cannabis advertisement exposure and problematic cannabis use among those living in medical-only states ($r_s = .40$, $p < .01$) relative to nonmedical states ($r_s = .004$, $p = .97$).

Policy Implications: More frequent exposure to cannabis advertisements in youth ages 16-20 may not relate to past-month cannabis use in legal cannabis states, but instead may increase risk of CUD in medical-only states instead of nonmedical cannabis states. Considerable research is needed to replicate these findings, and to determine whether there is a consistent difference in the effects of cannabis advertisement between jurisdictions including states with no legal cannabis laws. Future research is needed that leverages prospective research designs and uses control states. Results from such future research could provide targeted insights regarding restrictions to the frequency, modality (e.g., digital, paper, etc.), and jurisdiction (e.g., illegal vs. medical-only vs. nonmedical use) in which cannabis advertisements are placed.

Future Directions: Each of the following findings and policy insights will be gleaned from the Regulatory Determinants of Cannabis Outcomes Survey (RDCOS) by the fall of 2022:

- Longitudinal analyses of modality and frequency of cannabis advertisements by jurisdiction (illegal, medical-only, nonmedical use), age group (e.g., 16-20 years old, 21-25, 26-34, 35-44, 45-54, 55-64, 65 and older), gender, family income, substance use disorder subgroups, illicit opioid use subgroups, and economic and physical health outcomes.

- Difference-in-differences analysis of the role of nonmedical use implementation on cannabis use prevalence, amount, potency (THC), cannabis-related hospitalizations, CUD, and other health conditions.
- Analyses of the role of nonmedical use implementation on frequency and type of cannabis advertisement exposure and the specific causal impact (or lack thereof) of advertisement exposure as a moderating or mediating variable predicting cannabis use prevalence, amount, potency (THC), cannabis-related hospitalizations, CUD, and other health conditions.

Introduction: Approximately 1 in every 5 twelfth graders in the United States reports using cannabis at least once in the past month (MTF, 2022). This statistic is concerning given that cannabis use during adolescence and young adulthood is associated with increased risk for psychosis, depression and anxiety, cognitive impairments, and worse vocational outcomes (Hosseini, 2018; Hammond, 2020; Tu, 2009; Patton, 2002; Weinberger, 2020; Thomsen, 2021). Moreover, youth cannabis use is associated with increased risk of cannabis use disorder (CUD), such that some studies have reported that 1 in 3 youth who use cannabis transition to CUD (Thomsen, 2021). While many documented factors have been shown to relate to higher risks of initiating cannabis use in youth, the dynamic rise in cannabis regulation raises the concern that greater exposure to cannabis advertisements is associated with recent cannabis use (Whitehill, 2020; D'Amico, 2018; Dai, 2017), and ultimately, greater risk of CUD (Trangenstein, 2021). For example, a cross-sectional study on 15-19 year-olds from four adult-use cannabis states found that greater exposure to cannabis advertisements on social media is associated with increased odds of past year cannabis use (Whitehill, 2020). Similarly, a seven-year longitudinal study on adolescents aged 11 to 19 in southern California found positive associations between medical cannabis advertisement exposure and past month cannabis use (D'Amico, 2018). Few studies have examined the relationships between exposure to cannabis advertisements and cannabis use prevalence, and only one study to our knowledge has examined the association between cannabis advertisements and both cannabis use and CUD status (Trangenstein, 2021). Trangenstein and colleagues (2021), found that greater exposure to billboard advertisements and social media advertisements is associated with greater odds of both weekly cannabis use and CUD. However, this study only measured exposure to two types of advertisements, which is problematic given that most states with legal cannabis laws use multiple platforms such as billboards, in-store advertisements, paper flyers, email, text, and social media advertisements (Rup, 2020). To address these gaps, we examine the prevalence of seven forms of cannabis advertisements among youth (ages 16-20) and compare between 10 medical and 10 nonmedical cannabis use states. Further, we investigate the associations between frequency cannabis advertisement exposure among youth and both past-month use prevalence of CUD prevalence separately in medical-only and non-medical states, and test whether exposure to cannabis advertisements is differentially associated with past-month prevalence of CUD in either medical-only or nonmedical use states. The goal of this study is to quickly advance knowledge on the prevalence and potential impact of exposure to cannabis advertisements among youth to directly inform future public messaging and policy levers designed to mitigate risks of cannabis-related harms.

Methods.

Recruitment. The Institutional Review Board (IRB) at Advocates for Human Potential approved all procedures of the present study. The survey was conducted using Qualtrics survey software. Multiple responses from a single individual were prevented using Qualtrics' survey platform or excluded afterwards if missed by Qualtrics. We used Qualtrics' CAPTCHA verification was used to reduce the likelihood of computer bots completing the survey on behalf of humans. Participants were recruited using Lucid Research Panels. Participants completed the informed consent prior to beginning the survey. The only three inclusion criteria were age of 16 years or older, past year cannabis use, and residency in one of 20 states that has medical and/or nonmedical use cannabis regulation in place (Arizona, California, Connecticut, Florida, Georgia, Illinois, Maine, Maryland, Massachusetts, Michigan, Minnesota, Nevada, New Hampshire, New Jersey, New Mexico, New York, Ohio, Pennsylvania, Virginia, and Washington). A total of 4,862 participants who used cannabis in the past year completed the entire survey, and 340 were 16-20 years old and thus were included in the current study.

Measures.

Cannabis Use. Participants indicated the number of days (zero, 1-4, 5-10, 11-19, 20-29, or all 30 days) that they used cannabis in the past 30 days. To create a dichotomous past week use variable, all participants that reported "daily" or "once or twice weekly" use were classified as a "yes" and all others as a "no". Participants also reported the age that they first used cannabis with 9 response options that ranged from "13 and younger" to "21 and older".

Cannabis Use Disorder Identification Test – Short Form (CUDIT-SF). The CUDIT-SF was used to provide a continuous score of problematic use and a dichotomous outcome representing the likely presence of CUD or not. The CUDIT-SF uses question numbers 3, 5 and 6 of the Cannabis Use Disorder Identification Test –Revised (CUDIT-R) and was found to demonstrate sufficient sensitivity and specificity for identifying CUD (Adamson et al., 2015). Participants responded with either never (0), less than monthly (+1), monthly, weekly (+2), daily (+3) or almost daily (+4) for each item.

The items included "How often during the past 6 months did you find that you were not able to stop using cannabis once you had started?" (Did not try to stop, less than monthly, weekly, daily or almost daily), "How often in the past 6 months have you devoted a great deal of time to getting, using, or recovering from cannabis?" and "How often in the past 6 months have you had a problem with your memory or concentration after using cannabis?" Previous evidence suggests that the optimal cutoff score for CUD with the CUDIT-SF is a summed score of +2, thus those participants with a summed score of 2 or higher were denoted as meeting criteria for CUD in this study. The continuous measure (problematic use) was represented by the summed score.

Exposure to Cannabis Advertisements Index. We focused on the sum number of cannabis advertisements observed in the past month as a predictor for past month cannabis use and CUDIT-SF response. In the survey, participants noted the number of times (zero times, one time, more than one time scored as 0, 1, and 2) in the past month that they observed cannabis advertisements in each of the following forms: print, radio, billboards, website, emails or texts, cannabis dispensaries or stores, and other. We summed the total number of ads observed across all forms for each participant. The summed score was used as an index measure for exposure to cannabis advertisements.

Characteristics by Jurisdiction and Outcome Among a Sample of Participants Who Have Used Cannabis At Least Once in the Past Year

	All States	Med + Adult-Use States	Medical-only States	P-value
Age (M, SEM)	18.7 (.06)	18.7 (.10)	18.6 (.08)	.91
Gender (% , n)				.54
Male	21% (71)	20% (29)	21% (42)	
Female	73% (247)	71% (102)	74% (145)	
Gender non-conforming	6% (19)	8% (8)	4% (8)	
Chose to not respond	1% (3)	1% (1)	1% (2)	
Education (Mdn, IQR Range)	4 (3)	4 (3)	4 (3)	.90
Family Income (Mdn, IRQ Range)	3 (6)	3 (6)	3 (5.5)	.31
Total Grams Per Month	20.2 (1.46)	18.8 (2.17)	21.2 (1.98)	.42
CUD Status (% , n)	58% (2196)	52% (75)	61% (121)	.10
Generalized Anxiety Disorder-2 (% , n)	66% (223)	69% (98)	63% (125)	.33
Patient Health Questionnaire-2 (% , n)	63% (213)	66% (94)	60% (119)	.32
Ad Exposure Index (M, SEM)	4.6 (.18)	4.8 (.27)	4.4 (.24)	.17
Age of First Cannabis Use	17 (5)	17 (6)	17 (5)	.71

Analysis. We conducted four logistic regression models examining the dichotomous outcomes of weekly cannabis use prevalence (no/yes) and CUD status (no/yes) among those 16-20 years old for those in medical only states (two models) and those in nonmedical use states (two models). Receiver Operating Curve (ROC) analyses were conducted for each of the four logistic regression models to determine overall model accuracy. The summed exposure to cannabis advertisements predictor was entered into each of these four models in combination with age, education, gender, family income, age of first cannabis use, and both anxiety and depression symptoms based on evidence from previous studies demonstrating significant associations between these variables and frequency of cannabis use (Keyes, 2022; Hammond, 2022; Hamilton, 2019) and CUD (Winters, 2008; Kilmer, 2022). The CUDIT-R summed score was used to create the recommended CUD status cutoff score (i.e., >1) and to represent a continuous measure of problematic cannabis use. Participants self-reported cannabis use prevalence (i.e., daily, once or twice per week, once or twice in the past month, use in the past year but not in the past month, use in the past two years but not in the past year, used more than two years ago, never used cannabis) which was used to identify whether or not participants reported using at least once or twice a week or more (no/yes). In all logistic regressions, Omnibus Tests of Model Coefficients were used to determine significance of overall models, and odds ratios were used to determine the effect of the predictor on the dependent variables.

RESULTS

Table 1 shows the participant characteristics for nonmedical use (n=143) and medical-only states (n=197) for the sum of cannabis advertisements exposed to, education, family income, gender, cannabis amount last month (grams), anxiety status (no/yes), depression status (no/yes), and age. Chi-squared tests were used to compare differences between those from nonmedical use states and those in medical-only states for categorical variables and independent sample t-tests were used for continuous measures. No significant differences were observed between any variable when compared across those in nonmedical use states and those in medical-only states.

Cannabis Advertisement Exposure Findings. When controlling for education, gender, family income, anxiety, depression, age of first cannabis use, and age, we found that neither nonmedical use nor medical-only states showed a significant association between cannabis advertisement exposure and past month use prevalence ($p > .27$). For nonmedical use states, there was not a significant association between cannabis advertisement exposure and CUD status ($p = .64$); however, in medical-only states cannabis advertisement exposure was predictive of increased risk for meeting criteria for CUD ($p < .01$), with each additional advertisement increasing the risk of having CUD by about 18% ($OR = 1.18$, $p < .01$).

Covariate Results. In medical-only states, meeting criteria for depression using the PHQ-2 was associated with 2.49 times higher risk of using cannabis at least weekly ($OR = 2.49$, $p < .05$) and 2.32 times higher risk of CUD ($OR = 2.32$, $p < .05$). Higher age (i.e., range of 16-20) was associated with a higher risk of at least weekly use ($OR = 1.51$, $p < .05$). In nonmedical use states, lower family income ($OR = .89$, $p < .05$), lower age of first cannabis use ($OR = .74$, $p < .01$), and higher age ($OR = 1.46$, $p < .05$) were each associated with elevated risk of at least weekly cannabis use. Higher education ($OR = 1.35$, $p < .05$) and lower age of first use ($OR = .83$, $p = .05$) were associated with greater risk of meeting criteria for CUD.

	<u>Weekly Cannabis Use Status</u>					<u>CUD</u>					
	B	AUC 0.69		Sig.	Exp(B)	B	AUC 0.70		Sig.	ExpB	
		S.E.	Wald				S.E.	Wald			
<u>Med-Only States</u>	Ad Exposure	0.1	0.05	1.2	0.27	1.06	0.2	0.05	10.0	0.00	1.18
	Education	0.0	0.09	0.3	0.60	0.95	0.1	0.09	0.7	0.41	1.08
	Income	-0.1	0.04	2.4	0.12	0.94	0.0	0.04	1.1	0.30	0.96
	Gender	-0.3	0.23	1.9	0.17	0.73	0.0	0.20	0.0	1.00	1.00
	Age First Use	-0.1	0.08	1.0	0.33	0.92	0.0	0.08	0.4	0.55	1.05
	Anxiety	-0.1	0.39	0.0	0.88	0.94	0.0	0.39	0.0	0.96	1.02
	Depression	0.9	0.38	5.9	0.02	2.49	0.8	0.37	5.1	0.02	2.32
	Age	0.4	0.16	6.9	0.01	1.51	-0.1	0.15	0.4	0.50	0.90
	<u>Weekly Cannabis Use Status</u>					<u>CUD</u>					
	B	AUC 0.73		Sig.	Exp(B)	B	AUC 0.66		Sig.	ExpB	
		S.E.	Wald				S.E.	Wald			
<u>Nonmedical Use States</u>	Ad Exposure	0.0	0.06	0.0	0.88	0.99	0.0	0.06	0.2	0.64	0.97
	Education	0.2	0.12	2.5	0.11	1.20	0.3	0.11	6.9	0.01	1.35
	Income	-0.1	0.05	5.2	0.02	0.89	0.0	0.05	0.8	0.38	0.96
	Gender	-0.1	0.26	0.1	0.72	0.91	-0.2	0.28	0.8	0.38	0.78
	Age First Use	-0.3	0.10	9.5	0.00	0.74	-0.2	0.09	4.0	0.05	0.83
	Anxiety	0.1	0.48	0.0	0.89	1.07	0.3	0.45	0.5	0.48	1.37
	Depression	0.1	0.45	0.0	0.87	1.08	-0.8	0.44	3.1	0.08	0.46
	Age	0.4	0.18	4.5	0.04	1.46	-0.1	0.17	0.7	0.42	0.87

Table 4 shows the results of a series of exploratory analyses wherein Spearman's rank order correlation coefficients were determined between cannabis use frequency days in the past month, CUD severity scores (i.e., sum of CUDIT-SF scores) for those living states only with medical cannabis laws and those living in states with nonmedical cannabis laws. The strength of correlations for each of these outcomes are statistically compared between the two jurisdictions groups using Fisher r-to-z transformation and Z-score tests. The results showed similar strength correlations between ad exposure and cannabis use frequency days for both medical-only and nonmedical states. **However, the result of Z-score test (Z=-3.78, p <.001) showed that there was a stronger relationship between cannabis advertisement exposure and problematic cannabis use among those living in medical-only states (rs =.40, p <.01) relative to nonmedical states (rs =.004, p = .97).**

	<u>Problematic Cannabis Use</u>	<u>Frequency of Cannabis Use Days</u>
<u>Medical-Only States</u>	r = .40, p<.01	r =.15, p<.05
<u>Nonmedical Use States</u>	r =.004, p=.97	r =.17, p<.05

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