

Cross-substance Effects of Adolescent Exposure to Alcohol Content in Popular Movies on Cannabis Initiation

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ABSTRACT

Objective: Alcohol is the most frequently depicted substance in the media, and adolescent exposure to alcohol in the media predicts alcohol use. There is relatively little research on exposure to cannabis in the media, but exposure to alcohol content may exert cross-substance effects on cannabis use. Given the social and health risks associated with early cannabis use, the present study aims to assess the cross-substance effects of exposure to alcohol media content on age of cannabis initiation. **Method:** A sample of 830 middle school students (53% female) reported on movie alcohol exposure and cannabis initiation longitudinally until high school completion. Discrete-time survival models examined whether movie alcohol exposure predicted subsequent initiation among students who were cannabis-naïve at baseline, controlling for demographic, social, and behavioral covariates. The interaction between sex and movie alcohol exposure was also explored. **Results:** One third (33%) of participants reported cannabis initiation with a mean of 5.57 estimated hours ($SD = 4.29$) of movie alcohol exposure. A 1-hour increase in movie exposure predicted a significant 16% increased probability of cannabis initiation in models adjusted for demographic variables and a significant 14% increase in models adjusted for demographic, behavioral, and social variables. No differences were observed across sex. **Conclusions:** Greater adolescent exposure to alcohol content in the media was associated with earlier cannabis initiation above and beyond other etiologically relevant demographic, behavioral, and social variables. The influence of cross-substance media exposures warrants further exploration and should be taken into consideration in the development of preventive interventions for youth substance use.

Key words: = media; alcohol; cannabis; adolescent; survival analysis

Cannabis initiation in youth is concerning due to its adverse impacts on brain development (USDHHS, 2016), educational and occupational attainment (Beverly et al., 2019), and increased risk for cannabis use disorder in adulthood (Rioux et al., 2018; Leung et al., 2020). Recent research has identified exposure to cannabis in the media as a risk factor for initiating or increasing cannabis use (Primack et al., 2009; Whitehill et al., 2020; Trangenstein et al., 2019). Less is known about how exposure to other substances,

such as alcohol, may impact cannabis-related behaviors. Given alcohol's predominance in the media compared to other substances (Castaldelli-Maia et al., 2021; Sargent et al., 2006), the functional similarities between cannabis and alcohol, and the increasing availability and decreasing perceived risk of cannabis (Garcia Ramirez et al., 2020), this is an important gap in the literature.

Media is a prominent environmental influence on youth lives, including as a source of social

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learning (Bandura, 1971), and there is consistent and strong evidence for the link between exposure to alcohol in the media and subsequent adolescent alcohol use (Jackson et al., 2018; Jernigan et al., 2016; Hanewinkel et al., 2007; Waylen et al., 2015; Anderson et al., 2009). Although adolescents are exposed to all substances in the media, they are exposed to alcohol content in the forms of both unbranded and branded content (i.e., product placements for marketing purposes; Bergamini et al., 2013) more than any other substance. An analysis of Oscar-nominated movies between 2008-2011 found that 50.1% featured alcohol, 13% featured alcohol alongside another substance, and 2.5% featured cannabis (Castaldelli-Maia et al., 2021). Of the 50 most popular movies on Netflix in 2020, 76% included alcohol use by secondary characters and 66% by primary characters (Giannakodimos et al., 2022). These depictions are disproportionately positive, often displaying the benefits of alcohol use (e.g., fun, stress relief) more than the risks (Sargent et al., 2002; Russell et al., 2021; Merrill et al., 2023; Gosselt et al., 2017; Bhatia et al., 2023).

The Message Interpretation Process Model (MIP) posits that the impact of exposure to media content is determined by one's cognitive and emotional response to it (Austin & Johnson, 1997; Austin & Meili, 1994; Austin et al., 2006; Hoffman et al., 2014). As applied to alcohol media, adolescent exposure to frequent positive media depictions of alcohol has been shown to impact alcohol-related cognitions and emotions, such as expectancies about the positive effects of alcohol, perceived norms about approval of alcohol use, and attitudes favoring alcohol use (Grube & Waiters, 2005; Janssen et al., 2018; Nesi et al., 2017; Brooks-Russell et al., 2014; Merrill et al., 2023). In a qualitative study with adolescents, exposure to alcohol online and in the media was described as promoting a sense of normalcy and as minimizing negative consequences, such as hangovers and addiction (Merrill et al., 2023). One quoted adolescent linked alcohol depictions to cannabis, describing them in similar contexts and as reflective of similar personae (Merrill et al., 2023). Thus, it is possible that exposure to alcohol use in the media impacts adolescent cognitions and perspectives on other related behaviors, such as cannabis use.

While there is growing evidence of similar impacts of exposure to cannabis in the media on

adolescent cannabis use, alcohol in the media is an environmental risk worthy of further exploration given its relative frequency of appearance compared to cannabis. The social learning concept of generalization, whereby expectations about one form of substance use might translate to a functionally related behavior (Bandura, 1986; Andrews et al., 1993), provides theoretical justification for exploration of cross-substance effects. The functional relationship between cannabis and alcohol is strong (e.g., Metrik et al., 2018), with cannabis and alcohol commonly co-used (Patrick et al., 2019; Jackson et al., 2021; Banks, Rowe, Mpofu, & Zapolski, 2017) and found in the same physical contexts (Jackson et al., 2021). There is evidence that use of one substance increases likelihood of future use of the other (Wang et al., 2018). There is also overlap with characterological predictors of cannabis use and alcohol use, including impulsivity, sensation seeking, and parental monitoring (e.g., Janssen et al., 2018; Kaynak et al., 2013; Rioux et al., 2019; VanderVeen et al., 2016). Thus, the same cognitive and affective mechanisms driving the impact of exposure to alcohol media on alcohol use may also extend to cannabis.

Cross- or multi-substance effects have been illustrated in previous studies with different populations or modalities; young adults (18-24) exposed to peer alcohol content on social media were more likely to report both alcohol and cannabis use (Stoddard et al., 2012) and younger adolescent (10-14) exposure to R-rated movies positively associates with early initiation and progression of both cannabis and alcohol use (Stoolmiller et al., 2010). These findings, paired with increasing legalization of recreational and medical marijuana, increasing availability of cannabis, and decreasing perception of cannabis-related risk, warrant exploration of other environmental risk factors for cannabis use. Limiting analyses to within-substance effects (i.e., how exposure to alcohol impacts alcohol use) may paint an incomplete picture of the complex risk of media substance use.

To address current gaps in the literature and given the high volume and low regulation of media alcohol depictions compared to other substances, the present investigation explores cross-substance effects of exposure to alcohol in popular movies on subsequent cannabis initiation. Analyses control for demographic, social, and

behavioral factors shown to be associated with both alcohol and cannabis use. This study utilized a rigorous measure of movie alcohol exposure (Sargent et al., 2002a; Sargent et al., 2002b; Sargent et al., 2006; Stoolmiller et al., 2010) and a highly specific measure of cannabis initiation across time. We also examined whether sex at birth moderated the role of media exposure to alcohol, based on findings suggesting sex differences in associations between exposure to substances in the media and subsequent use (Boyle et al., 2016; AlSayyari & AlBuhairan, 2018).

METHODS

Participants

This study utilized secondary data analysis with a subset of data from a prospective study on alcohol use (Jackson et al., 2021). Participants were recruited from six Rhode Island middle schools from rural ($n = 231$), suburban ($n = 508$), and urban ($n = 284$) contexts and were relatively equally divided across sixth (33%), seventh (32%), and eighth grades (35%). We stopped school recruitment when we reached our sample goal of 1,000. All students were eligible for study participation, regardless of drinking status. Our analytic subset was selected from those who completed movie alcohol exposure assessment ($n = 882$) and consists of those that did not yet use cannabis at that time ($n = 830$) to explore subsequent cannabis use among non-users. Mean age at baseline for the analytic subset was 12.4 years ($SD = 0.9$), predominately female (53%) and White (78%). See Table 1 for sample descriptives. The sample did not differ from the full sample on sex, socioeconomic status, or ethnicity, but were significantly more likely to be White, $X^2(6, N = 830) = 19.22, p < .01$. For additional sample characteristics, see Jackson et al., 2014, 2015, 2018, and 2021.

Procedures

Consent forms were both mailed and distributed in classrooms. Once parent consent and adolescent assent was received, adolescent participants completed an in-person orientation session and both youth and their parents completed a baseline self-report paper-and-pencil

Table 1. *Sample Descriptives*

	<i>M/n</i>	<i>SD/ %</i>
Participants	830	--
Youth age at baseline (<i>M/SD</i>)	-12.4	-0.91
Youth sex at birth	--	--
Male	385	47
Female	445	53
Youth race	--	--
White or Caucasian	649	78
Black or AA	35	4
American Indian or Alaskan Native	13	2
Asian	22	3
Multiracial	56	7
Native Hawaiian or Other Pacific Islander	4	1
Don't know / prefer not to answer	51	6
Youth ethnicity	--	--
Hispanic/Latino	101	12
Not Hispanic/Latino	729	88
Receipt of lunch subsidy	--	--
Yes	273	35
No	508	65
Hours of movie alcohol exposure (<i>M/SD</i>)	-5.57	-4.29
Sensation seeking (<i>M/SD</i>)	2.24	0.84
Baseline alcohol use	--	--
Yes	50	6
No	776	94
Best friend cannabis use	--	--
Yes	35	4
No	780	96
Parent AUDIT (<i>M/SD</i>)	-2.61	-2.4

survey. Participants were then assessed over three years via five semi-annual surveys (every 6 months) and a sixth survey one year later. Participants were then re-enrolled (82% retention) into a quarterly follow-up study that spanned enrollment through high school graduation (number of assessments varied as a function of grade at enrollment and school cohort). All study procedures were approved by Brown University's Institutional Review Board, and a Certificate of Confidentiality was obtained from the National Institutes of Health to protect participant confidentiality.

Measures

Demographics. Youth sex (assigned at birth), race, ethnicity, and receipt of lunch subsidy (proxy

for socioeconomic status) were assessed at baseline. Participant responses to sex, race, and ethnicity items were re-coded into binary variables for analytic purposes (i.e., Male and Female, White and non-White, Hispanic and non-Hispanic, respectively).

Cannabis use. Cannabis use behavior was assessed at each wave by asking participants “Have you ever used marijuana (pot, hash, hash oil, etc.)?” Age of cannabis initiation was determined by the age at which cannabis-naïve individuals at baseline first indicated having ever used cannabis.

Alcohol onset. Alcohol use onset was assessed at each wave by asking participants “Have you ever consumed alcohol?” Responses were included in analyses as a binary yes or no variable indicating whether alcohol onset had occurred at each time point.

Movie alcohol exposure. Media alcohol exposure was first assessed at a semi-annual follow-up timepoint that varied as a function of school cohort. Exposure to alcohol in movies was calculated using a method that combines content analysis and random assignment of movie titles to youth surveys (Sargent et al., 2002a; Sargent et al., 2002b; Sargent et al., 2006; Stoolmiller et al., 2010). Specifically, the top 100 Box office hits from 2006-2010 were coded by 2 trained content coders for real or implied alcohol use, with an average Krippendorff alpha of .76 for the 10% double coded. Average alcohol time per movie was calculated. Each participant was shown a random sample of 50 movies (the cover art and title) and asked whether they had seen the movie and how many times. A measure of scaled alcohol exposure was established by calculating the minutes from movies that participants reported seeing, divided by the total minutes possible within their set of 50 movies, and multiplying by total duration of all 100 movies. Further details about this method with respect to the present sample are reported in Jackson et al. (2018, 2021).

Sensation seeking. Sensation seeking was assessed with six items from the UPPS-P Impulsive Behavior Scale ($\alpha = .82$; Lynam et al., 2006). Sample items include “I generally seek new and exciting experiences and sensations” and “I sometimes like doing things that are a bit frightening.”

Peer cannabis use. Peer cannabis use was assessed by asking “Think of your three best

friends (the friends you feel closest to). In the past 6 months, have any of your friends used marijuana?” (Arthur et al., 2000). Participants responded yes or no to this prompt.

Parent alcohol use. Parent alcohol use, behaviors, and related difficulties were assessed by asking the parent reporter to complete the Alcohol Use Disorders Identification Test (AUDIT; Saunders et al., 1993) for themselves and their partner, if applicable. Responses ranged from never/no (0) to four or more times a week/daily or almost daily/during the last year (4). A mean score of both caregiver responses was created for inclusion in analysis.

Analysis Strategy

We used discrete-time survival analysis (D TSA; Singer & Willett, 1993; Willett & Singer, 1993) in Mplus 8.3 (Muthén & Muthén, 1998-2017) to examine whether the first assessment of movie alcohol exposure prospectively predicted subsequent cannabis initiation among students who were cannabis-naïve at the time of movie alcohol exposure assessment ($n = 830$). We tested an unadjusted model predicting the age of cannabis initiation based on exposure to alcohol in movies, as well as adjusted models to assess whether demographic, social, and behavioral variables increase or decrease the hazard of cannabis initiation over time. Model 1 adjusted for demographic variables (sex, race, ethnicity, receipt of lunch subsidy), and Model 2 adjusted for demographic variables as well as select behavioral (sensation seeking, time-varying alcohol onset) and social (peer cannabis use, parent alcohol use) variables. Participant sex was tested as a moderator by creating a linear interaction variable representing the product of sex and media alcohol exposure. The effect of exposure to alcohol in movies was consistent across time, thus confirming the proportional hazards assumption. All models used full-information maximum likelihood estimation and handled missing data under assumption of Missing At Random. Predictors with missing data (e.g., parent alcohol use, receipt of lunch subsidy) were made endogenous to the model by regressing them on other predictors without missing data (sex, race, ethnicity), which prevented cases with missing data on these predictors from being removed from the model in a listwise fashion.

RESULTS

Across 15 time points (ages 11.5 to 18.5 years), 33% ($n = 307/830$) of previously cannabis-naïve participants reported cannabis initiation. Among all who contributed movie exposure data, 35% ($n = 309/882$) of participants reported using both cannabis and alcohol at some point during the study, with 65% ($n = 574/882$) reporting initiation of either cannabis or alcohol and 9% ($n = 78/882$) of participants initiating both at the same time. Seventeen percent ($n = 152/882$) of participants initiated cannabis use prior to alcohol use (including cases where alcohol was subsequently initiated and those where it was not), and 39% ($n = 344/882$) reported initiating alcohol use prior to cannabis use (including cases where cannabis was subsequently initiated and those where it was not). Thirty-five percent ($n = 307/882$) of participants did not endorse initiating either cannabis or alcohol use during the study.

Based on a random sample of movies, participants reported a scaled average of 5.57 estimated hours (standard deviation [SD] = 4.29) of movie alcohol exposure (See Table 1). A one SD increase in scaled movie exposure predicted a 19% [95% CI OR: 1.05 – 1.33] increased probability of cannabis initiation in fully unadjusted models. In Model 1, adjusting for demographic factors of sex, race, ethnicity, and lunch subsidy use, a one SD increase in scaled movie exposure predicted a 16% increased probability of cannabis initiation (95% CI OR: 1.02 – 1.31; see Figure 1). Survival ratios were calculated for participant cannabis

initiation, reflecting that those with lower (1- SD) exposure to alcohol in movies were less likely to report cannabis initiation by the age of 18.5 (or study completion), and those with higher movie alcohol exposure were more likely to have reported cannabis initiation by age 18.5 (or study completion). Hispanic ethnicity (HR = 1.13; 95% CI OR 1.06 – 1.21) and receipt of lunch subsidy (HR = 1.54; 95% CI OR: 1.19 – 1.98) were significant predictors of age of cannabis initiation while sex and race were not (see Table 2).

In Model 2, adjusting for demographic, behavioral (sensation seeking, time-varying alcohol onset) and social (peer cannabis use, parent AUDIT) covariates, a one SD increase in scaled movie exposure resulted in a 14% increased probability in cannabis initiation (95% CI OR: 1.01 – 1.29; See Table 2). Hispanic ethnicity (HR = 1.14; 95% CI OR 1.06 – 1.21), receipt of lunch subsidy (HR = 1.51; 95% CI OR: 1.17 – 1.95), time-varying alcohol onset (HR = 3.59; 95% CI OR: 2.34 – 5.49) and peer cannabis use (HR = 2.59; 95% CI OR 1.58 – 4.22) were significant predictors, while sex, race, parent AUDIT score and sensation seeking were not (see Table 2).

A subsequent model examined whether the effect of movie alcohol exposure on cannabis initiation was dependent on participant sex, via moderation. The interaction term from this model (adjusted for sex, race, ethnicity, and receipt of lunch subsidy) was non-significant (HR = 1.01, $p = .96$), suggesting that the effect of movie exposure on cannabis initiation did not differ by sex at birth.

Figure 1. *Survival curve of cannabis initiation as a product of exposure to alcohol in movies from ages 11.5 to 18.5.*

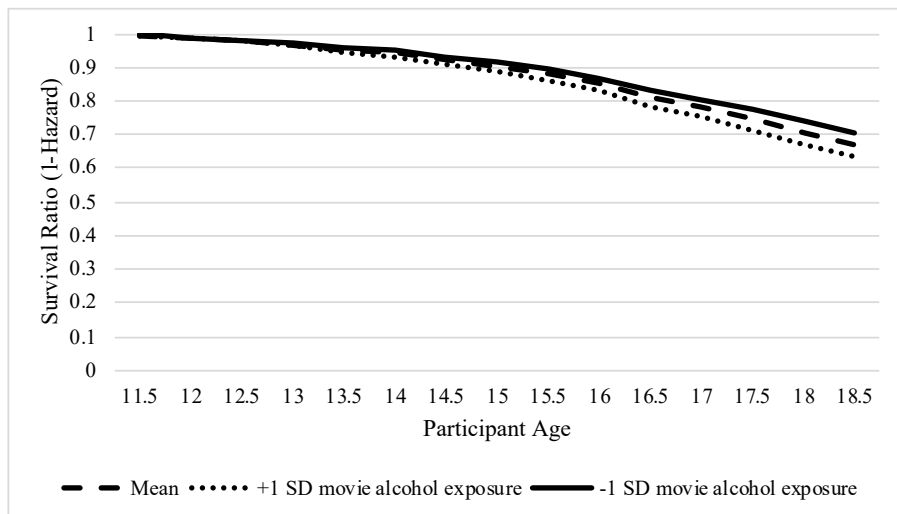


Table 2. *Estimates for the Discrete-Time Survival Model Predicting Cannabis Initiation (n = 830).*

		HR Confidence Interval			
		HR	95% LL	95% UL	<i>p</i>
Model 1	Movie alcohol exposure	1.16	1.02	1.31	0.019
	Sex (1=male)	0.82	0.65	1.04	0.099
	Race (1=White)	0.88	0.63	1.23	0.452
	Ethnicity (1=Hispanic)	1.13	1.06	1.21	<.001
	Receipt of lunch subsidy (Y/N)	1.54	1.19	1.98	0.001
Model 2	Movie alcohol exposure	1.14	1.01	1.29	0.041
	Sex (1=male)	0.83	0.65	1.05	0.113
	Receipt of lunch subsidy (Y/N)	1.51	1.17	1.95	0.002
	Race (1=White)	0.83	0.6	1.15	0.264
	Ethnicity (1=Hispanic)	1.14	1.07	1.21	<.001
	Time-varying (T-1) alcohol onset (Y/N)	3.59	2.34	5.49	<.001

Note. HR=Hazard ratio; Y/N = Response options Yes or No; LL: Lower limit; UL: Upper limit.

DISCUSSION

The present study demonstrated that hours of exposure to alcohol in movies was associated with increased likelihood of cannabis initiation at a younger age. This was demonstrated even in rigorous analyses controlling for contemporaneous alcohol use as well as youth demographic variables (sex, lunch subsidy, race, ethnicity), alcohol onset, peer cannabis use, parent alcohol use, and sensation seeking. Sex was not a significant moderator of the relationship between movie alcohol exposure and cannabis use, meaning that exposure to media substance use similarly impacted age of cannabis initiation across males and females. Given the prominence of substances in the media and deleterious effects of early cannabis use (Hawke et al., 2020), continued exploration of the nature of these associations and potential mitigating factors remains important for prevention efforts.

Approximately one third of previously cannabis-naïve participants reported initiating cannabis during the study, with almost all initiating alcohol use as well. It was more common for participants to initiate alcohol use prior to cannabis use rather than the reverse, although many initiated both substances at the same time. Additionally, results suggest that adolescents were significantly more likely to initiate cannabis use earlier when they had initiated alcohol use, providing support for the shared context and frequent co-occurrence of alcohol and cannabis use (Jackson et al., 2021). A valuable future direction would be exploration of these

relationships and developmental substance use trajectories in an older, higher-risk sample.

Peer cannabis use also resulted in a hazard ratio notably higher than that of movie alcohol exposure, suggesting that, while exposure to substances in the media increases risk, peer behaviors remain one of the largest risk factors for youth substance use (Stoolmiller et al., 2012). This is aligned with recent qualitative findings in which adolescents reported perceiving peer alcohol-related social media posts to be more influential for teen behaviors than influencer alcohol-related social media posts (Corcoran et al., 2023). An important future direction may be an exploration of how peer influences and media exposure to substances interact to impact adolescent substance-related attitudes and behaviors. Other significant covariates included prior year alcohol use, Hispanic ethnicity, and lower socioeconomic status, somewhat consistent with earlier findings (e.g., Wu et al., 2015). Taken together, these findings contribute to a nuanced and complex understanding of youth cannabis onset, whereby media, individual, and social influences all contribute to risk.

A consequence of cross-substance media effects is that youth with repeated exposure to multiple substances in the media may have greater risk for initiation of all substances. This is concerning given the extent of media substance exposures across media modalities, including television, streaming services, social media, online marketing. For example, alcohol depictions and marketing content are common and accessible to underaged youth on TikTok (Russell, 2021),

Twitter (Barry et al., 2016; Cabrera-Nguyen et al., 2016; Litt et al., 2018), and YouTube (Barry et al., 2015). Qualitatively, adolescents report seeing alcohol content on social media frequently, originating from both influencers and peers and including both branded and unbranded content (Corcoran et al., 2023). Even when educational and warning content is available on alcohol-related posts, content with risk-taking and celebratory themes tend to elicit more likes and views (Lim et al., 2021). Cannabis content is also common on social media (Cabrera-Nyugen et al., 2016; Whitehill et al., 2020). Future research should aim to develop methodology for systematically quantifying these exposures across modalities to get a more comprehensive perspective on youth substance-related exposures and ascertain whether the cross-substance effects identified in the present study apply more broadly.

Across media modalities, the regulations and trends specific to any one substance likely implicate the others. For example, alcohol marketing (including product placements in movies) is self-regulated (Noel et al., 2017), which is not effective in minimizing exposures to youth (Noel et al., 2017). Cannabis, on the other hand, is subject to more complicated regulations due to its status as a schedule I drug nationally and variable legal status across states, largely limiting marketing to specific conditions on social media or situations in which content will not cross state lines (Whitehill et al., 2020; Moreno et al., 2023; Berg et al., 2023). This will almost certainly shift as states continue to legalize cannabis (Borodovsky et al., 2016, 2017); as of August 2023, 24 states have legalized its use as compared to 4 in 2015 (DISA, 2023; Leins et al., 2021; Laurence, 2023). Legalization has been found to associate with a decrease in perceived risk of cannabis use among adolescents (Maxwell & Mendelson, 2016), which may further increase use and the cannabis-related social media content youth are exposed to. Another notable trend has been the proliferation of e-cigarettes and vape pens, which can be used to consume cannabis in a discrete way (e.g., not immediately identifiable as cannabis, vapor instead of smoke, subtle design). These characteristics hinder monitoring and prevention efforts (Ramamurthi et al., 2019) and likely increase youth exposure to vaped substances. Thus, the present study provides support for a

more comprehensive consideration of media influences on youth substance behavior beyond exposure to one specific substance.

From a preventive standpoint, media exposure to substance use, which is modifiable at a policy or family level, may be a promising environment risk factor on which to intervene. Evidence exists for the protective effects of media parenting behaviors on youth risk behavior (Cox et al., 2018), which would be expected to cut across multiple online risks (e.g., exposure to a range of different types of substances). Parental media mediation involves the employment of media-specific parenting behaviors, such as talking to children about what they are seeing and doing online, educating children about online risks and safe media use, co-viewing or co-using media and technology, and house rules (Gabrielli et al., 2018). Present findings suggest media parenting approaches may be most effective for reduction of youth risk for substance use behavior if applied broadly across substance content. For example, if parents notice a child being exposed to alcohol advertising in the media, they may want to discuss how multiple substance use industries (including cannabis and tobacco industries) may underplay the risks involved with use of substances.

Study limitations include the study sample being drawn from one region of the US exclusively with overrepresentation of White participants and underrepresentation of Black and Hispanic participants. Future studies may aim to replicate these findings with more nationally representative samples. Additionally, it is possible that the identified relationship between media exposure to substances and cannabis use is, in part, a product of a general association between substance use and media use. However, studies on media exposure to substance use have controlled for general media use, with significant media substance effects enduring (Gabrielli et al., 2021). Thus, although media usage alone may have an effect, it appears that substance use in the media has an effect above and beyond that of general media use alone. We also did not control for cannabis exposures; some of the alcohol exposures coded may have also included cannabis. That said, given data on the relative frequency of substance depictions (e.g., Castaldelli-Maia, 2021), this is unlikely to have accounted for present associations. Furthermore, cannabis content

coding of media may be more complicated (e.g., a vape pen may or may not include cannabis) than alcohol content coding, which has a much stronger foundation of literature support. Strengths of the present study include a robust measure of youth movie alcohol exposure, a longitudinal design with repeated measures of substance use behavior, and a substance-use naïve sample at baseline.

Cannabis initiation and use in youth, particularly at high volumes and frequencies, may result in detrimental health and social outcomes. Gaining a greater understanding of modifiable environmental influences to substance use initiation and progression is important for prevention and intervention efforts. The present study identified an association between alcohol exposures in the media and subsequent cannabis initiation. Future research should continue to explore non-specific media exposures as a potential influence on youth substance initiation. As it is unlikely that alcohol depictions will decrease in the media in the near future, and cannabis depictions may increase, an understanding of cross-substance and general substance media effects is important.

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