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Cannabis Marketing Restrictions and Exposure to Cannabis Marketing in Legal US Cannabis Markets: Findings From the International Cannabis Policy Study

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ABSTRACT

Introduction: A growing number of US states have legalised adult 'recreational' cannabis. Restrictions on advertising and promotions are a key component of cannabis regulations in legal markets; however, there is little evidence on the impact of restrictions. This study examines differences in cannabis marketing exposure by the strength of marketing restrictions among US states with legal recreational sales.

Methods: Data are from the International Cannabis Policy Study: repeated cross-sectional surveys conducted annually (2018–2023) with 99,132 respondents aged 16–65. The 'strength' of marketing restrictions was measured using regulatory documents in 20 states with legal recreational cannabis sales. Adjusted mixed effects logistic regression models were fitted to analyse differences in past-12 month noticing of cannabis marketing by the strength of marketing restrictions overall and within specific marketing channels.

Results: People in states with low and moderate strength marketing restrictions reported similar exposure to cannabis marketing (61.4% and 61.8%, respectively). Compared to those with moderate strength restrictions, people in states with the highest strength restrictions reported the lowest exposure (53.4%: $p = 0.037$), with no significant differences for states with low strength restrictions ($p = 0.067$). Comprehensive restrictions on marketing via billboards and posters, and at sports events were associated with reductions in reported exposure to these channels. Cannabis marketing exposure was highest among people below the minimum legal age (16–20 years old; 63.0%: $p < 0.001$).

Discussion and Conclusions: Stronger regulations may reduce exposure to marketing in states with recreational cannabis markets; however, existing regulations appear to be inadequate to prevent advertising and promotions from reaching young people.

1 | Introduction

As of 2025, 24 US states have legalised the 'recreational' use of cannabis for adults [1]. In the United States, recreational legalisation is typically followed by the introduction of a legal market and licensed cannabis retailers; however, legal sales can take months or years to commence. Restrictions on cannabis advertising and promotions, or 'cannabis marketing', are a key component of the regulatory framework for legal markets at the state level, particularly for protecting young people from inducements to use cannabis [2–4]. Exposure to cannabis marketing, particularly among youth, may increase the risk of early initiation and is associated with cannabis use and cannabis use disorder among adolescents [5–7]; both of which may be linked with an increased risk of psychosis and other mental health conditions [8, 9].

Key Points

- Underaged respondents (16–20 years) reported high levels of cannabis marketing exposure in legal recreational cannabis markets.
- Cannabis marketing within certain marketing channels, such as social media, was disproportionately noticed by underaged respondents (16–20 years).
- Comprehensive marketing restrictions may reduce overall exposure to cannabis marketing.

There is vast evidence on the impact of marketing on the use of legal, regulated substances, such as tobacco and alcohol [5, 6]. For example, extensive research demonstrates the causal role of tobacco marketing in promoting smoking initiation among young people [6, 7]. Conversely, there is also evidence that comprehensive restrictions on tobacco marketing are effective in reducing tobacco use, particularly among youth and young adults [7, 10, 11]. Substantially less evidence exists on the impact of cannabis marketing policies, largely due to the relative novelty of legal cannabis markets and limited regulatory experiences. While early evidence suggests associations between cannabis marketing exposure and increases in use [12–15], research evaluating the effectiveness of current marketing regulations is largely absent. Additionally, it is important to note that while tobacco is often used as a regulatory comparator to the cannabis industry, the health impacts of tobacco are overwhelmingly negative [7]; whereas the health impacts of cannabis are more nuanced [16].

To date, marketing restrictions in states with recreational cannabis markets are highly variable. A policy scan conducted in June 2021 among the 31 states with legal medical or recreational cannabis found the majority of states prohibited cannabis advertisements that appeal to minors, although fewer than half of states restricted the physical locations of advertisements [17]. Additionally, many regulations have ill-defined criteria for what constitutes 'appeal to minors' and lack clear restrictions across the full range of marketing channels, including digital media [13, 18, 19]. The use of social media for cannabis marketing presents a particular challenge for restricting access to those that are underage, considering that almost 90% of Americans have used social media by the age of 18, and over a third by the age of 13 [20]. Adolescent engagement with cannabis marketing on social media is associated with increased past-year and past-28-day cannabis use, as well as increased symptoms of cannabis use disorder [18, 21]. However, the relationship between noticing cannabis advertising and cannabis use is likely bidirectional: exposure to marketing may increase susceptibility to use cannabis, while cannabis consumers are also more likely to seek out and be exposed to cannabis marketing [13–15, 22].

Despite an increase in the number of US states that are legalising recreational cannabis [2, 3], the effectiveness of regulatory measures in protecting young people from cannabis marketing remains unclear. The primary objective of the current study was to examine differences in marketing restrictions among states that have legalised recreational cannabis and had legal sales at the time of data collection, to understand whether the 'strength' of marketing restrictions was associated with exposure to cannabis marketing, both overall and in specific marketing channels. The study also sought to examine differences in exposure to cannabis marketing by frequency of cannabis use, authorisation for medical cannabis and differences by sociodemographic factors including age, sex at birth, education, race and income adequacy.

2 | Methods

2.1 | Study Design

Data are from population-based repeated cross-sectional surveys conducted in the United States across six annual waves (2018–2023) as part of the International Cannabis Policy Study (ICPS). The current study sample was restricted to respondents from states with legal recreational cannabis sales at the time of collection. Data were collected from respondents aged 16–65 via web-based surveys conducted in August–September 2018, September–October 2019, September–November 2020, September–November 2021, September–October 2022 and September–October 2023. Respondents were recruited through the Nielsen Consumer Insights Global Panel and their partners' panels. The Nielsen panels were recruited using a variety of probability and non-probability sampling methods. For the ICPS surveys, Nielsen draws stratified random samples from the online panels, with quotas based on age and state of residence. Respondents received remuneration upon completion in accordance with their panel's usual incentive structure. Median survey time was approximately 22 min. The study was reviewed by and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE #31330). A full description of the study methods is available in the Technical Reports and methodology paper [23].

2.2 | Measures

2.2.1 | Frequency of Cannabis Use

Respondents were categorised based on frequency of cannabis use: 'Never consumers'; 'Consumed more than 12 months ago'; 'Less than monthly, but in the past 12-month consumers'; 'Monthly to Weekly consumers' and 'Daily consumers'.

2.2.2 | Medical Authorisation Status

Among those who have ever used cannabis, respondents were further classified into 3 categories based on medical authorisation status: 'Never authorised'; 'Ever authorised' (previously authorised to use medical cannabis but not within the last 12 months) and 'Currently authorised' (authorised to use medical cannabis within the last 12 months).

2.2.3 | Sociodemographic Variables

Respondents provided sociodemographic information, including sex at birth, age, race, education level, perceived income

adequacy and state of residence. Respondents were classified into age groups: 16–20 years, 21–30 years, 31–50 years and 51–65 years. Race was assessed with measures drawn from the US Census Bureau [24]. Income adequacy, which is associated with objective measures of income and wealth [23], was used as a proxy measure of income, assessed by asking 'Thinking about your family's income, how difficult or easy is it to make ends meet?' (on a 5-point Likert scale ranging from 'Very difficult' to 'Very easy').

2.2.4 | Time Since Legal Sales Began

The variable for 'time since legal sales began' is time-varying at the state level. Respondents were classified based on time since legal sales began in their state of residence at the time of data collection: '< 1 year since legal sales began'; '1–3 years since legal sales began' and '4+ years since legal sales began'. State classifications are available in Table S1.

2.2.5 | Strength of Advertising Restrictions

For each state where regulated cannabis retailers were operational, state regulations were reviewed in April 2024 and independently scored by two reviewers based on the strength of the state's marketing restrictions for recreational cannabis products. Two measures were used to examine the strength of advertising restrictions. First, a 'Channel Restriction Score' ranging from 1 to 5 (Level 1 = lowest strength) was assigned for each of 11 individual marketing channels (see Table S2 for channel classification criteria). Classification criteria were based on common themes in regulatory documents, and whether rules and regulations apply to all cannabis-related marketing or marketing of 'products' only (i.e., restrictions do not apply to marketing of cannabis brands or 'branding' where no specific product is advertised). Second, an overall index or summary score—the 'State Restriction Score'—was created by summing the Channel Restriction Score across the 11 channels within each state. State restriction score was analysed as a categorical variable corresponding to three levels: low strength (score between 11 and 33), moderate strength (sum between 34 and 39) and high strength (sum between 40 and 55; see Table S1 for restriction scores). State restriction score cut-offs were determined based on distributing states and respondents as evenly as possible.

2.2.6 | Exposure to Cannabis Marketing

'Noticing cannabis advertising' or self-reported exposure was measured with the question 'In the past 12 months, have you noticed marijuana being advertised or promoted in any of the following places?' Respondents could select all that applied to indicate 'yes' for each of the 11 specific channels shown in Table S2; 'Other' (with the option to specify); 'I have not noticed marijuana being advertised or promoted'; 'Don't know'; or 'Refuse to answer'. Responses were recoded into a dichotomous response variable (0 = no advertisements noticed vs. 1 = at least one advertisement noticed). An index variable was also created for the mean number of channels noticed (*Noticing Index*). Responses of 'Don't know' and 'I have not noticed marijuana being advertised or promoted' will be coded as 'no exposure to cannabis marketing', and refusals were removed from the analytic sample.

2.3 | Statistical Analysis

Analyses were conducted using SAS (SAS 9.4, SAS Institute Inc., Cary, NC, USA). A total of 1278 respondents were removed for non-response/refusal for education and noticing cannabis advertisements—the primary dependent variable—for an overall sample size of 99,132 eligible respondents. Given the small proportion of missing data (approximately 1% of the sample), no further analyses of missing data were conducted. Estimates were weighted to population targets based on age-by-sex-by-state, education-by-state, region-by-race and age-by-cigarette smoking status groups where state was grouped for all states with samples of less than 800 respondents and region refers to the nine US Census Divisions. A raking algorithm was applied to compute weights calibrated to these groupings. All analyses used weights rescaled to the study sample size.

Descriptive statistics and unadjusted point estimates were used to characterise the sample profile and primary outcomes. A mixed effects logistic regression model (the 'GLIMMIX' procedure in SAS) was fitted to analyse overall noticing of at least 1 advertisement or promotion in any channel (i.e., 'overall exposure') in the past 12 months (vs. no advertisements or promotions noticed) by state restriction score group. In a sensitivity analysis, a linear regression model was fitted to *Noticing Index* across state restriction score groups, for which unstandardised β (β), 95% confidence intervals (CI) and p values were reported. A secondary analysis was conducted where separate GLIMMIX models were fitted to analyse dichotomous noticing for each of the 11 individual marketing channels by channel restriction score. All GLIMMIX models were fitted with a variance component covariance and a random intercept for US state of residence, for which adjusted ORs, 95% CIs and p values were reported. In all cases, models were adjusted for time since legal sales began, sex, income adequacy, race, education, cannabis use frequency and age.

3 | Results

3.1 | Sample Characteristics

Unweighted and weighted sample characteristics are presented in Table S4. Across all six survey waves, approximately one-third of all respondents reported never trying cannabis (30.6%), while a similar proportion reported consuming cannabis at least once monthly (29.6%).

3.2 | Exposure to Marketing via Any Channel

Table 1 presents regression results for self-reported cannabis marketing exposure in states with legal recreational cannabis sales (point estimates for self-reported exposure by state are presented in Table S5). The variance partition coefficient indicates the random intercept of state accounted for just over

TABLE 1 | Mixed effects logistic regression for noticing cannabis marketing within legal sales states, 2018–2023 ($n = 99{,}132$).

	% Noticed[a]	AOR (95% CI)	*p*
State restriction score			
Low strength: Score 11–33	61.4%	Ref	Ref
Moderate strength: Score 34–39	61.8%	1.03 (0.82, 1.29)	0.789
High strength: Score 40–55	53.4%	0.79 (0.62, 1.02)	0.067
Time since legal sales began			
< 1	53.1%	Ref	Ref
1–3 years	60.9%	1.34 (1.28, 1.40)	< 0.001
4+ years	64.6%	1.16 (1.09, 1.24)	< 0.001
Age			
16–20 years	63.0%	Ref	Ref
21–30 years	66.9%	0.85 (0.80, 0.91)	< 0.001
31–50 years	61.8%	0.62 (0.59, 0.66)	< 0.001
51–65 years	55.3%	0.48 (0.45, 0.51)	< 0.001
Frequency of use			
Never consumer	56.3%	Ref	Ref
Consumed more than 12 months ago	62.4%	1.37 (1.32, 1.41)	< 0.001
Past-12-month consumer	59.7%	1.12 (1.07, 1.17)	< 0.001
Monthly to weekly consumer	64.4%	1.34 (1.29, 1.40)	< 0.001
Daily consumer	65.3%	1.47 (1.41, 1.53)	< 0.001
Sex at birth			
Female	58.4%	0.81 (0.79, 0.83)	< 0.001
Male	63.6%	Ref	Ref
Education			
Less than high school	58.4%	Ref	Ref
High school diploma or equivalent	55.8%	1.06 (0.99, 1.13)	0.082
Some university/ college	61.4%	1.43 (1.34, 1.52)	< 0.001
Bachelor's degree or higher	64.2%	1.75 (1.64, 1.87)	< 0.001
Race			
White (non-Hispanic)	60.6%	Ref	Ref
White (Hispanic)	65.8%	1.19 (1.13, 1.24)	< 0.001
American Indian or Alaskan Native	63.6%	1.08 (0.97, 1.20)	0.176
Asian	54.6%	0.74 (0.69, 0.78)	< 0.001
Black or African American	59.8%	1.04 (0.99, 1.09)	0.121
Native Hawaiian or Pacific Islander	66.4%	1.16 (0.95, 1.42)	0.146
Other/2+ races	65.9%	1.16 (1.08, 1.24)	< 0.001
Unstated	55.2%	0.88 (0.80, 0.97)	0.012
Income adequacy			
Difficult or very difficult	61.6%	Ref	Ref
Neither easy nor difficult	59.3%	0.90 (0.87, 0.93)	< 0.001
Easy or very easy	64.1%	1.04 (1.01, 1.08)	0.014
Not stated	38.4%	0.38 (0.35, 0.41)	< 0.001
Variance of random intercept			
τ^2	0.0439		
VPC or ICC	0.0132		

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; ICC, intraclass correlation coefficient; VPC, variance partition coefficient.
[a]Point estimates for '% Noticed' are weighted but not adjusted for covariates.

1% of the variability in noticing. People in states with 'low' and 'moderate' strength marketing restrictions reported similar levels of cannabis marketing exposure (61.4% and 61.8%, respectively, Figure 1). People in states with 'high' strength restrictions reported the lowest cannabis marketing exposure relative to those with 'moderate' strength restrictions (53.4% noticed: adjusted odds ratio [AOR] 0.77; 95% CI 0.60–0.98; $p = 0.037$); however, differences in reported marketing

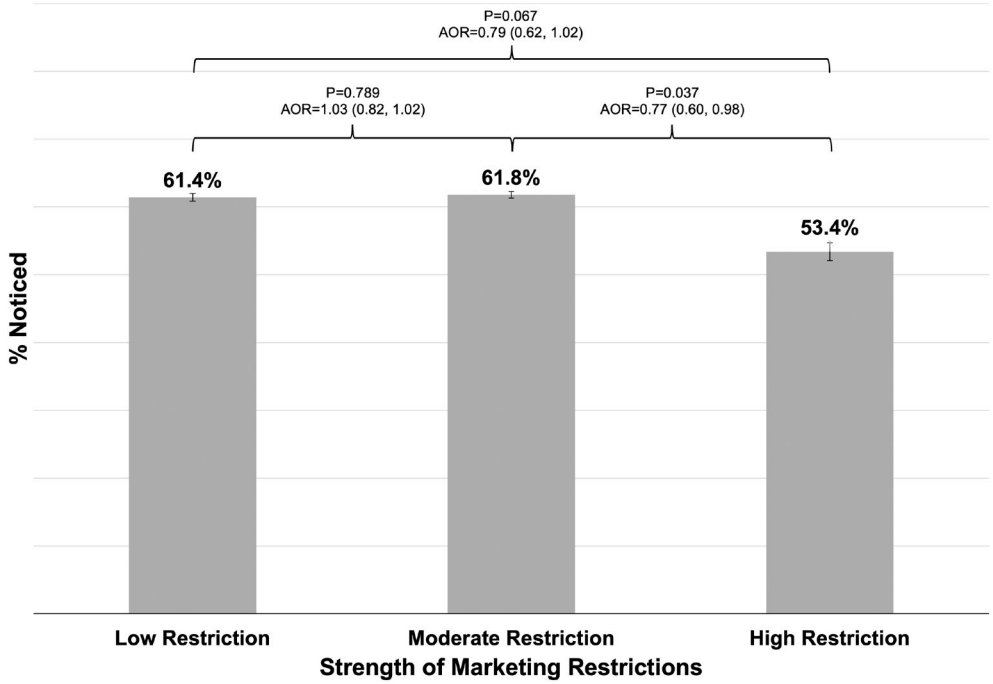

FIGURE 1 | Noticing cannabis marketing by state restriction score ($n = 99{,}132$).

exposure between 'high' and 'low' strength restrictions were not statistically significant ($p = 0.067$). Self-reported cannabis marketing exposure via any channel increased in the 1–3 years following the start of legal sales, relative to the first year that legal retailers were introduced (60.9% vs. 53.1% noticed: AOR 1.34; 95% CI 1.28–1.40; $p < 0.001$ see Figure S1). Following this initial increase 1–3 years after the start of legal sales, adjusted odds of self-reported noticing decreased slightly after four or more years in a legal market (64.6% noticed: AOR 0.87; 95% CI 0.83–0.91; $p < 0.001$).

Frequency of cannabis use was associated with different levels of noticing cannabis marketing. As shown in Table 1, daily consumers reported the greatest past-year marketing exposure relative to never consumers, who reported the lowest (65.3% vs. 56.3% noticed: AOR 1.47; 95% CI 1.41–1.53; $p < 0.001$). Age, sex at birth, education, race and income adequacy were also independently associated with differences in self-reported marketing exposure. In the adjusted model, the youngest age group with people aged 16–20 was associated with the greatest overall self-reported marketing exposure (63.0% noticed any channel; see Figure 2). Noticing decreased with age and was lowest among people aged 51–65 years (55.3%: AOR 0.48; 95% CI 0.45–0.51; $p \leq 0.001$). Females-at-birth were less likely to report cannabis marketing exposure than males-at-birth (58.4% vs. 63.6% noticed: AOR 0.81; 95% CI 0.79–0.83; $p \leq 0.001$). People with less than a high school education (58.4%), or a high school diploma (55.8%) reported similar levels of marketing exposure, whereas people with a Bachelor's degree or more reported the highest marketing exposure (64.2% noticed: AOR 1.75; 95% CI 1.64–1.87; $p < 0.001$). People identifying as Asian were associated with the lowest levels of noticing relative to those identifying as non-Hispanic Whites (54.6% vs. 60.6% noticed: AOR = 0.74; 95% CI 0.69–0.78; $p \leq 0.001$), and marketing exposure was highest among people that identified as Hispanic White (65.8%: AOR 1.19; 95% CI 1.13–1.24; $p < 0.001$), and 'Other' or two or more races (65.9%; AOR 1.16; 95% CI 1.08–1.24; $p < 0.001$ for all contrasts). In regard to income adequacy, cannabis marketing exposure was highest among people that reported it was 'easy or very easy' to make ends meet (64.1% noticed: AOR 1.04; 95% CI 1.01–1.08; $p = 0.014$), and people with unstated income adequacy reported the lowest cannabis marketing exposure relative to those that reported it was 'difficult or very difficult' to make ends meet (38.4% vs. 61.6%: AOR 0.38; 95% CI 0.35–0.41; $p < 0.001$).

Medical authorisation was explored in a separate model among people who had consumed cannabis at least once in their lifetime. Cannabis consumers that had 'never' been authorised to use medical cannabis reported the lowest marketing exposure (60.8%) with greater exposure reported among people that had 'ever' been authorised (72.7% noticed; AOR 1.67; 95% CI 1.55–1.80; $p < 0.001$) or were 'currently' authorised to use medical cannabis (79.4% noticed; AOR 2.38; 95% CI 2.22–2.54; $p < 0.001$).

3.3 | Mean Number of Channels Noticed

Table S6 presents an analysis of the *Noticing Index*. The *Noticing Index* represents the mean number of channels where cannabis marketing was noticed in the past 12 months (range 0–11). Relative to the year legal sales began (mean = 1.16), mean marketing channels noticed increased one to 3 years following the start of legal sales (mean = 1.45: $\beta = 0.24$; 95% CI 0.21–0.28; $p < 0.001$), and again four or more years after the start of legal sales (mean = 1.59: $\beta = 0.34$; 95% CI 0.30–0.38; $p < 0.001$). People in states with 'high strength' restrictions reported the lowest mean number of channels noticed relative to states with 'moderate strength' restrictions (mean = 1.17 vs. 1.45: $\beta = -0.14$;

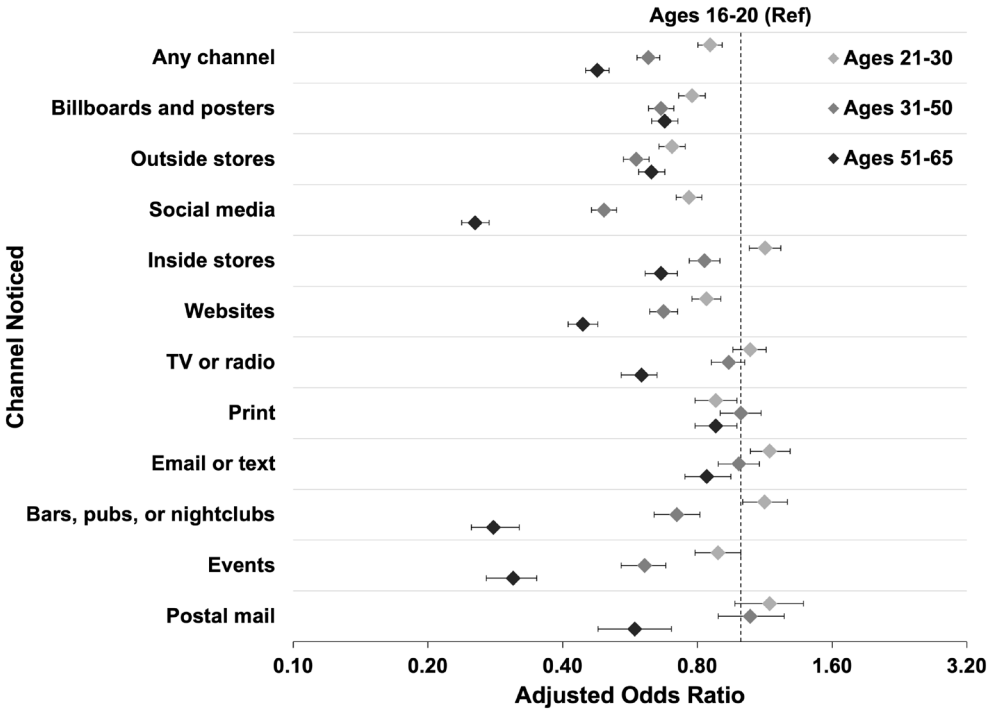

FIGURE 2 | Adjusted odds ratios for noticing cannabis marketing by age ($n = 99{,}132$).

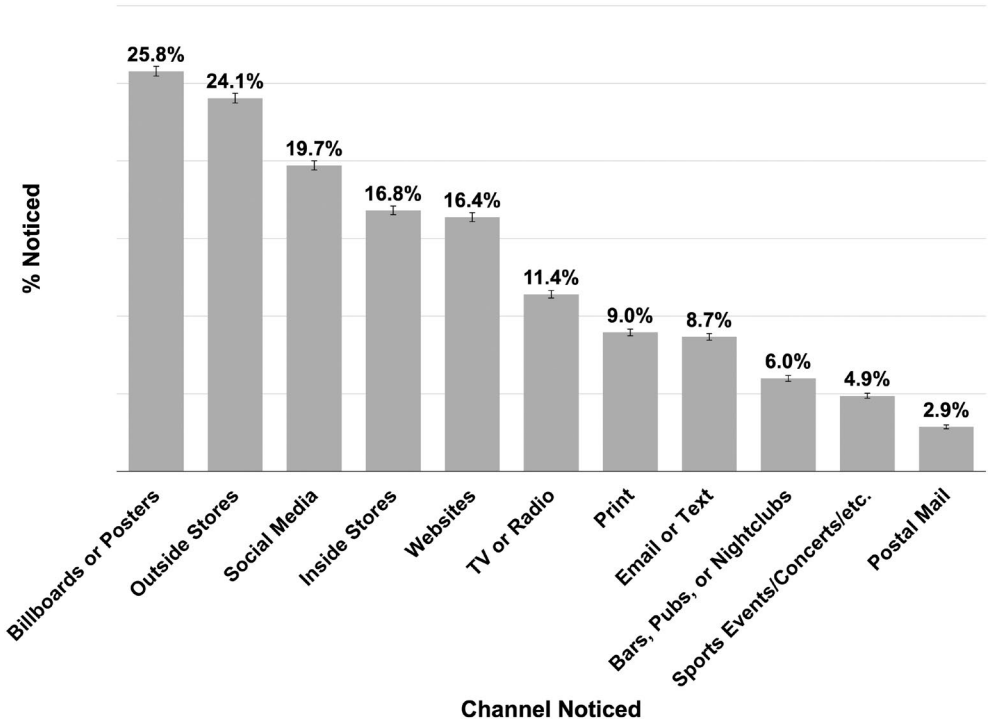

FIGURE 3 | Noticing cannabis marketing by channel in states with legal sales ($n = 99{,}132$).

95% CI −0.09, −0.19; $p < 0.001$) and 'low strength' restrictions (mean = 1.51: $\beta = -0.15$; 95% CI −0.20, −0.10; $p < 0.001$). Across all time periods, people in states with low and moderate strength restrictions reported a similar mean number of channels noticed. As shown in Table S6, being 16–20 years of age was associated with noticing more channels in the adjusted linear model (mean = 1.56), relative to all other age groups ($p \leq 0.001$ for all contrasts).

3.4 | Marketing Exposure by Channel

Figure 3 presents the average self-reported exposure in states with legal sales for each of the 11 channels included in the study. Noticing was greatest via billboards or posters (25.8% noticed), followed by outside stores (24.1%) and social media (19.7%). Fewer than 10% of people reported noticing cannabis ads via print, email or text, bars, sports or events or postal mail.

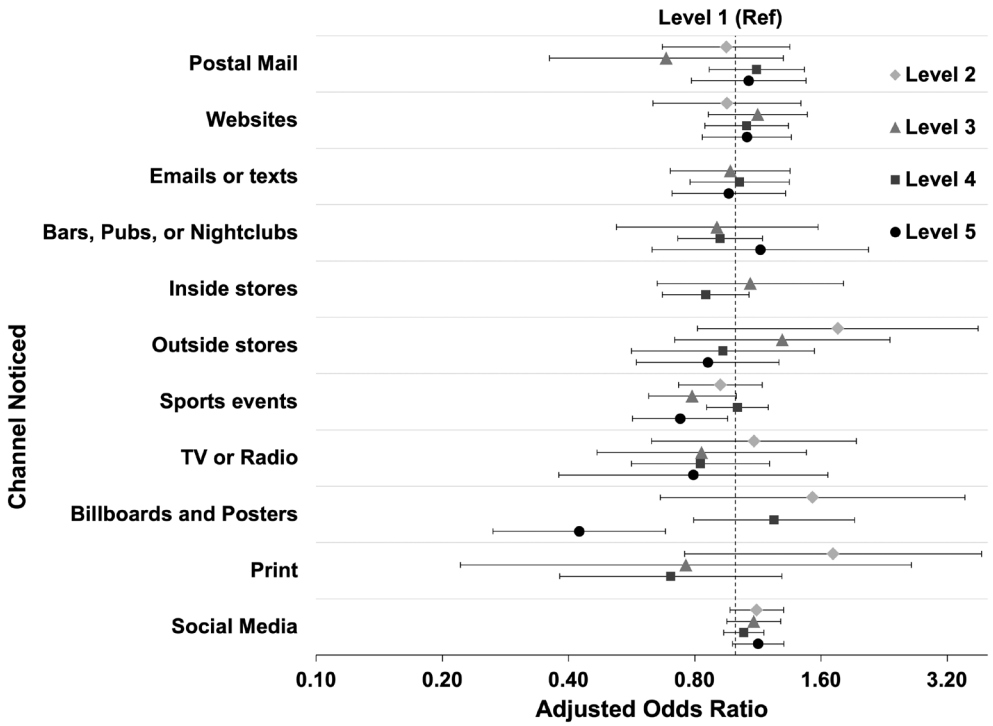

FIGURE 4 | Adjusted odds ratios for noticing cannabis marketing by channel restriction score.

Marketing exposure differed by the strength of channel restrictions in two channels: billboard or poster marketing and marketing at sport events (see Figure 4 and Tables S7–S17). Noticing cannabis marketing via billboards or posters was lowest in states with high strength channel restrictions relative to low strength (11.2% vs. 20.8% noticed: AOR 0.42; 95% CI 0.26–0.68; $p < 0.001$), with similar exposure reported for all other channel restriction levels. In addition, high-strength channel restrictions for marketing at sports events were associated with lower marketing exposure relative to low-strength restrictions (4.2% vs. 4.9% noticed: AOR 0.74; 95% CI 0.57–0.96; $p = 0.023$; see Figure 4). For all other marketing channels, channel restriction score was not associated with significant differences in marketing exposure. Tables S7–S17 show differences in noticing individual channels over time in legal markets. Noticing cannabis ads within individual channels also differed by age (Figure 2). In the adjusted model, people aged 16–20 reported the greatest exposure relative to all other age groups for channels: websites; outside stores; billboards and posters and social media ($p < 0.001$ for all contrasts).

4 | Discussion

Exposure to cannabis marketing has previously been shown to increase following recreational legalisation [25]; however, to our knowledge, this is the first study to evaluate differences in cannabis marketing exposure based on the strength or comprehensiveness of marketing restrictions in legal markets. There was some evidence that comprehensive restrictions could reduce overall exposure to cannabis marketing, but in the present study, differences were only observed between states with the highest level of marketing restrictions and those with moderate-strength restrictions. Previous literature demonstrates comprehensive restrictions can be effective in reducing exposure to tobacco marketing, with little or no evidence of impact for partial restrictions [6]. Findings should be interpreted within the broader context of other cannabis regulatory frameworks; in general, very few states had comprehensive marketing restrictions compared to other jurisdictions that have legalised cannabis, including Canada, Uruguay and Germany [17]. Even in states such as Montana, with relatively comprehensive advertising restrictions, restrictions did not apply to marketing of cannabis brands or companies where no specific products are advertised [26]. In other words, companies can engage in a wide array of promotional activities for cannabis stores and products, including traditional advertisements with promotional images, so long as no specific products are displayed. This is in contrast to Canada, where prohibitions for cannabis promotions include promotion of brand elements, and virtually all forms of advertising and promotion that are publicly visible are prohibited [27]. The potential impact of branding exposure when product marketing is absent warrants further consideration, given the high levels of self-reported marketing exposure in these jurisdictions.

Despite regulatory objectives to protect minors from cannabis marketing [17], people below the minimum legal age were most likely to report exposure to cannabis marketing after adjusting for covariates. Notably, previous research indicates youth exposure only surpasses that of other ages after recreational legalisation, suggesting a need for more comprehensive marketing restrictions in legal markets [25]. However, it is important to consider the potential impact of youth exposure to medical cannabis marketing, as research in medical jurisdictions has shown associations with increased cannabis use and intentions to use [28, 29]. Youth aged 16–20 reported

greater exposure than any other age group to cannabis marketing via websites, outside cannabis stores, event sponsorships, billboards and posters and social media. Current regulatory approaches for these channels often include audience composition requirements, where a specified proportion of the audience must be 21 or older, rather than complete prohibition. Younger ages are particularly susceptible to marketing given developmental changes that increase the need for social reassurance and acceptance, as well as greater adoption of new trends and products [30–32]. These findings suggest current approaches are insufficient to protect underaged people from cannabis marketing exposure, and more comprehensive restrictions or even prohibitions within these channels may be needed to achieve public health objectives. Future studies should continue to monitor long-term impacts of these regulations, including in jurisdictions outside the US where more comprehensive marketing restrictions have been implemented.

Frequent cannabis use was associated with higher levels of self-reported marketing exposure, similar to previous findings [18, 21]. Authorised medical cannabis consumers also reported greater exposure to cannabis marketing relative to recreational consumers; however—as with frequent cannabis use more broadly—it is important to consider this relationship is likely bidirectional [33]. People authorised to use medical cannabis likely have greater interaction with retail stores and companies through which they would be exposed to cannabis marketing; meanwhile, it is possible that frequent exposure to cannabis marketing may increase the likelihood of seeking authorisation, possibly through 'normalising' medical cannabis use.

Regarding individual channels, comprehensive channel restrictions were associated with significant reductions in exposure in billboard or poster advertising and advertising through sports event sponsorships. Several studies suggest low levels of compliance to state-level marketing restrictions, particularly for digital marketing such as social media [19, 34, 35]. 'Physical' marketing channels may be easier to regulate and enforce, in contrast to digital marketing channels [34, 36, 37]. This suggests more comprehensive restrictions on the most 'noticed' channels—billboards or posters and marketing outside stores—may effectively reduce cannabis marketing exposure. Future studies should examine compliance with marketing restrictions across a greater range of channels.

4.1 | Limitations

Data were collected via self-reported surveys with the potential for social desirability bias. To mitigate this, surveys were anonymised and self-administered online, and respondents were asked whether they answered questions truthfully. Respondents that answered 'no' are removed from the final sample. Recall bias at the individual level is also likely. Respondents may not accurately recall the number or type of cannabis marketing channels to which they were exposed, and younger people may also be more likely to recall advertisements than other age groups. Thus, self-reported exposure is likely to underestimate exposure to cannabis marketing at both the individual and population level. Nevertheless, previous research has demonstrated that self-reported measures of marketing exposure are correlated with objective measures of marketing, such as aggregate advertising expenditures and viewership data [38–40]. Additionally, ICPS data uses nonprobability-based sampling which may not be representative of true population estimates; however, data were weighted based on US census data [24].

There are also limitations associated with the coding and scoring of marketing restrictions based on state-level regulations. First, although comprehensive efforts were made to access and verify regulations, it is possible that some information was omitted. Second, there is variability across states in how 'advertising' was defined, and these distinctions are challenging to represent. In some cases, regulatory documents were vague and while efforts were made to contact regulatory agencies to clarify these issues for each state, only half responded to confirm coding. In several cases, representatives were unable to provide details or cited legal issues for not responding. Third, while scoring for the current study 'weighted' each marketing channel equally, some marketing channels may have a greater relative impact on marketing exposure than others. The importance of digital marketing channels and social media warrants special consideration given the ubiquitous reach of digital marketing and its particular appeal among young people [41, 42]. Additionally, while the current study analysed the overall 'strength' of marketing restrictions in three categories, future research should examine linear vs. non-linear effects of marketing restrictions, including any 'threshold' effects. Finally, some counties or municipalities have 'opted out' of legal retail stores, which would likely decrease marketing exposure within these jurisdictions. However, 'opt-out' counties were evenly distributed across restriction strength categories, reducing the likelihood of significant bias. Despite these challenges, the efforts to identify and categorise state-level restrictions on cannabis advertising represent the most comprehensive effort to date. Finally, the low prevalence of people identifying as a gender-minority prevented an examination of gender in the full analytical models. However, descriptive statistics provided in Table S18 suggest important differences that warrant further consideration.

5 | Conclusions

The relationship between marketing of substances and increased consumption is well-established, particularly among young people [18, 21]. In states with legal recreational cannabis sales, restrictions on cannabis marketing are a key component of state-level regulatory frameworks; however, regulatory approaches are highly variable and research evaluating different regulatory contexts is extremely limited. The current study indicates that comprehensive marketing restrictions may reduce exposure in states with legal recreational cannabis markets. Although protecting young people from cannabis promotions is a primary policy objective for virtually all states with legal cannabis markets, these findings highlight high levels of cannabis marketing exposure among young people, particularly among youth below the minimum legal age [2–4]. Future research should monitor changes in marketing exposure and effectiveness of advertising regulations as legal markets mature.

Author Contributions

Each author certifies that their contribution to this work meets the standards of the International Committee of Medical Journal Editors.

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Conflicts of Interest

D.H. has provided paid expert testimony on behalf of public health authorities in response to legal claims from the cannabis, tobacco and vaping industry. The other authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

References

1. National Conference of State Legislatures, "Cannabis Overview," 2024, https://www.ncsl.org/civil-and-criminal-justice/cannabis-overview.

2. National Conference of State Legislatures, "State Medical Cannabis Laws," National Conference of State Legislatures, 2023, https://www.ncsl.org/health/state-medical-cannabis-laws.

3. R. A. Barry and S. A. Glantz, "Marijuana Regulatory Frameworks in Four US States: An Analysis Against a Public Health Standard," *American Journal of Public Health* 108 (2018): 914–923, https://doi.org/10.2105/AJPH.2018.304401.

4. D. Hammond, S. Goodman, E. Wadsworth, V. Rynard, C. Boudreau, and W. Hall, "Evaluating the Impacts of Cannabis Legalization: The International Cannabis Policy Study," *International Journal on Drug Policy* 77 (2020): 102698, https://doi.org/10.1016/j.drugpo.2020.102698.

5. D. Jernigan, J. Noel, J. Landon, N. Thornton, and T. Lobstein, "Alcohol Marketing and Youth Alcohol Consumption: A Systematic Review of Longitudinal Studies Published Since 2008," *Addiction* 112 (2017): 7–20, https://doi.org/10.1111/add.13591.

6. National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health, *Preventing Tobacco Use Among Youth and Young Adults: A Report of the Surgeon General* (Centers for Disease Control and Prevention, 2012), http://www.ncbi.nlm.nih.gov/books/NBK99237/.

7. National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health, *The Health Consequences of Smoking—50 Years of Progress: A Report of the Surgeon General* (Centers for Disease Control and Prevention, 2014), http://www.ncbi.nlm.nih.gov/books/NBK179276/.

8. W. Hall, "What Has Research Over the Past Two Decades Revealed About the Adverse Health Effects of Recreational Cannabis Use?," *Addiction* 110 (2015): 19–35, https://doi.org/10.1111/add.12703.

9. N. D. Volkow, R. D. Baler, W. M. Compton, and S. R. B. Weiss, "Adverse Health Effects of Marijuana Use," *New England Journal of Medicine* 370 (2014): 2219–2227, https://doi.org/10.1056/NEJMra1402309.

10. H. Saffer and F. Chaloupka, "The Effect of Tobacco Advertising Bans on Tobacco Consumption," *Journal of Health Economics* 19 (2000): 1117–1137, https://doi.org/10.1016/S0167-6296(00)00054-0.

11. S. Akter, M. R. Islam, M. M. Rahman, et al., "Evaluation of Population-Level Tobacco Control Interventions and Health Outcomes: A Systematic Review and Meta-Analysis," *JAMA Network Open* 6 (2023): e2322341, https://doi.org/10.1001/jamanetworkopen.2023.22341.

12. A. M. Cohn, A. C. Alexander, S. J. Ehlke, et al., "Seeing Is Believing: How Cannabis Marketing Exposure Is Associated With Cannabis Use Attitudes and Behavior in a Permissive Medical Cannabis Policy Environment," *American Journal on Addictions* 32 (2023): 333–342, https://doi.org/10.1111/ajad.13390.

13. J. M. Whitehill, P. J. Trangenstein, M. C. Jenkins, D. H. Jernigan, and M. A. Moreno, "Exposure to Cannabis Marketing in Social and Traditional Media and Past-Year Use Among Adolescents in States With Legal Retail Cannabis," *Journal of Adolescent Health* 66 (2020): 247–254, https://doi.org/10.1016/j.jadohealth.2019.08.024.

14. P. J. Trangenstein, J. M. Whitehill, M. C. Jenkins, D. H. Jernigan, and M. A. Moreno, "Cannabis Marketing and Problematic Cannabis Use Among Adolescents," *Journal of Studies on Alcohol and Drugs* 82 (2021): 288–296, https://doi.org/10.15288/jsad.2021.82.288.

15. J. Rup, S. Goodman, and D. Hammond, "Cannabis Advertising, Promotion and Branding: Differences in Consumer Exposure Between 'Legal' and 'Illegal' Markets in Canada and the US," *Preventive Medicine* 133 (2020): 106013, https://doi.org/10.1016/j.ypmed.2020.106013.

16. M. Solmi, M. D. Toffol, J. Y. Kim, et al., "Balancing Risks and Benefits of Cannabis Use: Umbrella Review of Meta-Analyses of Randomised Controlled Trials and Observational Studies," *BMJ* 382 (2023): e072348, https://doi.org/10.1136/bmj-2022-072348.

17. N. C. Allard, J. S. Kruger, and D. J. Kruger, "Cannabis Advertising Policies in the United States: State-Level Variation and Comparison With Canada," *Cannabis and Cannabinoid Research* 8 (2023): 505–509, https://doi.org/10.1089/can.2022.0068.

18. P. J. Trangenstein, K. G. Combs, J. M. Whitehill, M. C. Jenkins, D. H. Jernigan, and M. A. Moreno, "Typology of Adolescents Exposed to Non-Medical Cannabis Marketing and Associations With Consumption Patterns," *Prevention Science* 23 (2022): 1276–1286, https://doi.org/10.1007/s11121-022-01378-0.

19. M. A. Moreno, M. Jenkins, K. Binger, et al., "A Content Analysis of Cannabis Company Adherence to Marketing Requirements in Four States," *Journal of Studies on Alcohol and Drugs* 83 (2022): 27–36, https://doi.org/10.15288/jsad.2022.83.27.

20. V. Rideout, "The Common Sense Census: Media Use by Tweens and Teens," Common Sense Media, November 2015, https://apo.org.au/node/58360.

21. P. J. Trangenstein, J. M. Whitehill, M. C. Jenkins, D. H. Jernigan, and M. A. Moreno, "Active Cannabis Marketing and Adolescent Past-Year Cannabis Use," *Drug and Alcohol Dependence* 204 (2019): 107548, https://doi.org/10.1016/j.drugalcdep.2019.107548.

22. E. P. Cabrera-Nguyen, P. Cavazos-Rehg, M. Krauss, L. J. Bierut, and M. A. Moreno, "Young Adults' Exposure to Alcohol- and Marijuana-Related Content on Twitter," *Journal of Studies on Alcohol and Drugs* 77 (2016): 349–353, https://doi.org/10.15288/jsad.2016.77.349.

23. D. Corsetti, F. Fataar, R. Burkhalter, and D. Hammond, *International Cannabis Policy Study Technical Report—Wave 5 (2022)* (University of Waterloo, 2023), http://cannabisproject.ca/methods/.

24. US Census Bureau, "State Population by Characteristics: 2020–2024, Census.gov," 2024, https://www.census.gov/data/tables/time-series/demo/popest/2020s-state-detail.html.

25. L. Winfield-Ward, E. Wadsworth, P. Driezen, V. L. Rynard, and D. Hammond, "Exposure to Cannabis Marketing in the United States and Differences by Cannabis Laws: Findings From the International Cannabis Policy Study," *Drug and Alcohol Dependence* 274 (2025): 112787, https://doi.org/10.1016/j.drugalcdep.2025.112787.

26. Christi Jacobsen—Montana Secretary of State, "Administrative Rules of Montana," August 12, 2024, https://rules.mt.gov/browse/colle

ctions/aec52c46-128e-4279-9068-8af5d5432d74/policies/7b4cb7d9-33da-44b0-88a5-aca320738efe.

27. Health Canada, "Promotion of Cannabis: Prohibitions and Permissions in the Cannabis Act and Regulations," 2018, https://www.canada.ca/en/health-canada/services/drugs-medication/cannabis/laws-regulations/promotion-prohibitions.html.

28. E. J. D'Amico, J. N. V. Miles, and J. S. Tucker, "Gateway to Curiosity: Medical Marijuana Ads and Intention and Use During Middle School," *Psychology of Addictive Behaviors* 29 (2015): 613–619, https://doi.org/10.1037/adb0000094.

29. E. J. D'Amico, A. Rodriguez, J. S. Tucker, E. R. Pedersen, and R. A. Shih, "Planting the Seed for Marijuana Use: Changes in Exposure to Medical Marijuana Advertising and Subsequent Adolescent Marijuana Use, Cognitions, and Consequences Over Seven Years," *Drug and Alcohol Dependence* 188 (2018): 385–391, https://doi.org/10.1016/j.drugalcdep.2018.03.031.

30. US Department of Health and Human Services, National Institutes of Health, National Cancer Institute, Division of Cancer Control and Population Sciences (DCCPS), "The Role of the Media in Promoting and Reducing Tobacco Use," 2008, https://cancercontrol.cancer.gov/brp/tcrb/monographs/monograph-19.

31. J. McKenna, K. Gutierrez, and K. McCall, "Strategies for an Effective Youth Counter-Marketing Program: Recommendations From Commercial Marketing Experts," *Journal of Public Health Management and Practice* 6 (2000): 7–13, https://doi.org/10.1097/00124784-200006030-00004.

32. P. Zollo, *Wise up to Teens: Insights Into Marketing and Advertising to Teenagers*, 2nd ed. (New Strategist Publications, 1999).

33. M. J. Krauss, S. J. Sowles, A. Sehi, et al., "Marijuana Advertising Exposure Among Current Marijuana Users in the U.S," *Drug and Alcohol Dependence* 174 (2017): 192–200, https://doi.org/10.1016/j.drugalcdep.2017.01.017.

34. S. Marinello, R. Valek, and L. M. Powell, "Analysis of Social Media Compliance With Cannabis Advertising Regulations: Evidence From Recreational Dispensaries in Illinois 1-Year Post-Legalization," *Journal of Cannabis Research* 6 (2024): 2, https://doi.org/10.1186/s42238-023-00208-6.

35. B. H. Carlini, S. Garrett, C. Firth, and I. Pinsky, "Cannabis Industry Marketing Violations in Washington State, 2014–2019," *Journal of Studies on Alcohol and Drugs* 83 (2022): 18–26, https://doi.org/10.15288/jsad.2022.83.18.

36. N. Y. Sheikhan, A. M. Pinto, D. A. Nowak, et al., "Compliance With Cannabis Act Regulations Regarding Online Promotion Among Canadian Commercial Cannabis-Licensed Firms," *JAMA Network Open* 4 (2021): e2116551, https://doi.org/10.1001/jamanetworkopen.2021.16551.

37. C. J. Berg, K. F. Romm, A. Pannell, et al., "Cannabis Retailer Marketing Strategies and Regulatory Compliance: A Surveillance Study of Retailers in 5 US Cities," *Addictive Behaviors* 143 (2023): 107696, https://doi.org/10.1016/j.addbeh.2023.107696.

38. E. C. Feighery, L. Henriksen, Y. Wang, N. C. Schleicher, and S. P. Fortmann, "An Evaluation of Four Measures of Adolescents' Exposure to Cigarette Marketing in Stores," *Nicotine & Tobacco Research* 8 (2006): 751–759, https://doi.org/10.1080/14622200601004125.

39. B. G. Southwell, C. H. Barmada, R. C. Hornik, and D. M. Maklan, "Can We Measure Encoded Exposure? Validation Evidence From a National Campaign," *Journal of Health Communication* 7 (2002): 445–453, https://doi.org/10.1080/10810730290001800.

40. A. R. Romberg, M. Bennett, S. Tulsiani, et al., "Validating Self-Reported Ad Recall as a Measure of Exposure to Digital Advertising: An Exploratory Analysis Using Ad Tracking Methodology," *International Journal of Environmental Research and Public Health* 17 (2020): 2185, https://doi.org/10.3390/ijerph17072185.

41. Pew Research Center, "Social Media Fact Sheet," 2024, https://www.pewresearch.org/internet/fact-sheet/social-media/.

42. L. Owen, C. Lewis, S. Auty, and M. Buijzen, "Is Children's Understanding of Nontraditional Advertising Comparable to Their Understanding of Television Advertising?," *Journal of Public Policy & Marketing* 32 (2013): 195–206.

Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Figure S1:** Adjusted odds ratios for noticing cannabis marketing by time since legal sales began ($n = 99,132$). **Table S1:** State-level legal status by survey wave. **Table S2:** Coding guide used to evaluate marketing channel restriction level. **Table S3:** Marketing restriction strength scores. **Table S4:** Sample characteristics. **Table S5:** Past-12-month self-reported noticing at least 1 cannabis ad or promotion by state (grouped by restriction level). **Table S6:** Linear regression for noticing index ($n = 99,132$). **Table S7:** Mixed effects logistic regression for noticing cannabis marketing in postal mail within recreational states ($n = 99,132$). **Table S8:** Mixed effects logistic regression for noticing cannabis marketing on websites within recreational states ($n = 99,132$). **Table S9:** Mixed effects logistic regression for noticing cannabis marketing in email or texts within recreational states ($n = 99,132$). **Table S10:** Mixed effects logistic regression for noticing cannabis marketing in bars, pubs or nightclubs ($n = 99,132$). **Table S11:** Mixed effects logistic regression for noticing cannabis marketing inside stores that sell marijuana within recreational states ($n = 99,132$). **Table S12:** Mixed effects logistic regression for noticing cannabis marketing outside stores that sell marijuana within recreational states ($n = 99,132$). **Table S13:** Mixed effects logistic regression for noticing cannabis marketing at events within recreational states ($n = 99,132$). **Table S14:** Mixed effects logistic regression for noticing cannabis marketing on TV or radio within recreational states ($n = 99,132$). **Table S15:** Mixed effects logistic regression for noticing cannabis marketing on billboards or posters within recreational states ($n = 99,132$). **Table S16:** Mixed effects logistic regression for noticing cannabis marketing in print newspapers or magazines within recreational states ($n = 99,132$). **Table S17:** Mixed effects logistic regression for noticing cannabis marketing on social media within recreational states ($n = 99,132$). **Table S18:** Noticing cannabis marketing by gender.