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Publication Date

2021-04-01

DOI

10.1016/j.addbeh.2020.106782

Peer reviewed

HHS Public Access

Author manuscript

Addict Behav. Author manuscript; available in PMC 2022 April 01.

Published in final edited form as:

Addict Behav. 2021 April ; 115: 106782. doi:10.1016/j.addbeh.2020.106782.

Post-Legalization Changes in Marijuana Use in a Sample of Young California Adults

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Abstract

Introduction: Increasing marijuana use among young adults is a concern due to substantial acute and chronic health risks. More widespread use of marijuana may also lead to increased use of nicotine and tobacco products. California legalized commercial sales of marijuana for recreational use as of January 2018. To our knowledge no studies to date have examined subsequent changes in marijuana use. The goal of this study was to test the hypothesis that marijuana use frequency increased following legalization of recreational sales. We also hypothesized that increased marijuana frequency would predict greater frequency of nicotine/tobacco consumption.

Methods: The study was a secondary analysis of a longitudinal study of tobacco use among non-daily cigarette smokers. Participants were 563 young adults (aged 18–24) enrolled in 2015–16 and followed quarterly for 3 years.

Results: A piecewise multilevel regression model indicated that marijuana use frequency did not change over time, including following legalization. More frequent use was associated with younger age and identifying as white (*p*s<.001, which did not change after legalization. Marijuana frequency was moderated by sex (*p*<.001), with women reporting increasing and men decreasing

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Contributors

Dr. Doran designed the parent study, obtained funding, led data collection, planned the data analysis, and drafted the manuscript. Drs. Doran, Strong and Myers designed this secondary data analysis and edited drafts of the manuscript. Dr. Correa and Ms. Tully conducted literature searches, provided summaries of previous studies, conducted the primary data analyses, and edited drafts of the manuscript. All authors contributed to and have approved the final manuscript.

Neal Doran: conceptualization, formal analysis, funding acquisition, investigation, methodology, project administration, supervision, original draft

David Strong: conceptualization, resources, review and editing

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Conflict of Interest

There are no conflicts of interest for any author.

use over time. It was also associated with tobacco use, and particularly with e-cigarette use following legalization (*p*s<.05).

Conclusions: Findings suggest legalization of recreational marijuana sales had a negligible overall impact on days of use among young adults, but may have prompted increased interest in marijuana among some, particularly women and e-cigarette users. The continuously evolving landscape around these products indicates that ongoing surveillance is critical.

Introduction

Recent changes in the marijuana environment in the United States include decreased restrictions on use (Pacula, Kilmer, Wagenaar, Chaloupka, & Caulkins, 2014), decreased perception of marijuana as harmful (Hasin, 2018; Okaneku, Vearrier, McKeever, LaSala, & Greenberg, 2015; Schuermeyer et al., 2014), and increased adult prevalence (Compton, Han, Jones, Blanco, & Hughes, 2016; Hasin et al., 2015). As of January 1, 2020, recreational use was legal in 11 states, and decriminalized in 15 others; medical use was legal in 33 (National Conference of State Legislatures, 2019). A primary concern about legalization is increased use among youth, but this concern has not been realized to date (Brooks-Russell et al., 2019; Johnson et al., 2019; Mauro et al., 2019b; Sarvet et al., 2018). However, there is evidence of increased marijuana use and cannabis use disorders (Hasin et al., 2017; Kerr, Bae, Phibbs, & Kern, 2017; Mauro et al., 2019b) among adults that appears to be concentrated among adults aged 26+ (Cerda et al., 2020; Mauro et al., 2019a).

While extant research suggests that legalization has not led to increased overall use among youth, some recent findings suggest possible increases among young adults (Mauro et al., 2019a). Repeated cross-sectional data suggest increased frequency of use among Oregon undergraduates after legalization in that state in 2015 (Kerr, Bae, & Koval, 2018). Additionally, early marijuana use may lead to cigarette smoking (Nguyen, Ebnesajjad, Stuart, Kennedy, & Johnson, 2019) and to poor occupational and educational outcomes (Thompson, Leadbeater, Ames, & Merrin, 2019) in young adulthood. It is also important to note that previous research on the impact of changing marijuana restrictions is largely limited to repeated cross-sectional data. There is a need for longitudinal cohort studies to identify not only trajectories of use but also predictors and correlates. Additionally, it is unclear whether loosening restrictions may have a differential impact on 18–20 year old young adults, for whom use remains illegal, compared with 21–24 year olds.

Despite decreasing public apprehension, there are reasonable concerns about young adult marijuana use. Acutely, marijuana increases risk for accidents (Brady & Li, 2014; Hartman & Huestis, 2013; Ramaekers, Bergaus, van Laar, & Drummer, 2004), emergency department visits (Substance Abuse and Mental Health Services Administration, 2011), and psychosis (Davis, Compton, Wang, Levin, & Blanco, 2013; Di Forti et al., 2015). Persistent use predicts poor psychosocial outcomes (Compton, Gfoerer, Conway, & Finger, 2014; Lynskey & Hall, 2000) and neuropsychological and cognitive decline in humans (M. Meier et al., 2012), and animal models suggest cognitive deficits and social anxiety (O'Shea, McGregor, & Mallet, 2006). Persistent use is associated with addiction (Lopez-Quintero

et al., 2011), including withdrawal (Gorelick et al., 2012). However, continued movement toward increased access makes it important to understand potential public health effects.

A further concern is whether legalization modulates tobacco use. Marijuana users appear less likely to quit tobacco (Schauer, King, & McAfee, 2017; Strong et al., 2018; Vogel, Rubinstein, Prochaska, & Ramo, 2018), and changes in use of either product are positively associated with changes in the other (Doran et al., 2019). Marijuana legalization could send the message that tobacco is also less dangerous than previously believed. In other words, legalization may undermine negative perceptions of tobacco use due to similar routes of administration, use of similar devices, and frequency of co-use (Apollonio et al., 2019; Giovenco, Spillane, Mauro, & Martins, 2018). This risk is particularly important during emerging adulthood, when tobacco initiation peaks (Perry et al., 2018) and patterns of long-term use are established (Fromme, Corbin, & Kruse, 2008). Marijuana use may also impair continuing brain development during this period (Lisdahl, Wright, Medina-Kirchner, Maple, & Shollenbarger, 2014; Sowell, Thompson, Holmes, Jernigan, & Toga, 1999).

California was the first state to legalize medical marijuana in 1996. At that time marijuana use was already high compared with other states, and the impact on prevalence was minimal (Hasin et al., 2017; Khatapoush & Hallfors, 2004). However, in 2016 California legalized recreational marijuana use, including possession of up to 1 ounce and individual cultivation beginning in November 2016, with commercial sales permitted as of January 1, 2018 (California Office of the Secretary of State, 2016). . State authorities began to plan for regulation of recreational sales in late 2016, and began issuing licenses for cultivation, manufacturing, distribution, testing, and retail sales at the beginning of January, 2018 (California Bureau of Cannabis Control, 2020). Local jurisdictions may still prohibit cultivation and sales. As of February 2018 there were 261 active retail licenses statewide; as of October 2020 that number had increased to 753, including 46 in San Diego County where this study was based (Control, 2020). A recent report based on a survey from 2018–19 indicates that young adults generally utilize legal avenues to access marijuana and only rarely acquire it from strangers or dealers (D'Amico et al., 2020).

To our knowledge, no research has evaluated changes in frequency of marijuana use in California following legalization of recreational sales, and there are few cohort studies from other states. The current study is one of the first to examine a sample of the same participants before and after legislation was implemented. Participants were at high risk for marijuana use given that all had smoked cigarettes recently at time of enrollment (Lemyre, Poliokova, & Belanger, 2019; Ramo, Liu, & Prochaska, 2012).

This study was a secondary analysis of a study of non-daily cigarette smokers in California who were aged 18–24 when they enrolled in 2015–16 and who were followed quarterly for 3 years. Although possession and individual cultivation were permitted during 2017, we focused on legalization of sales in the belief this would have greater impact on availability based on both increased direct sales to young adults and on diversion from peer groups. Based on recent studies among young adults (D'Amico et al., 2020; Kerr et al., 2018) and on the fact that their tobacco use status likely increased risk of marijuana use, we sought to test the hypothesis that frequency of marijuana use would increase following

legalization. A second goal was to test whether post-legalization changes in marijuana trajectories would be moderated by demographic (age, sex, race/ethnicity) or other substance use (alcohol, tobacco) factors. We expected to see greater increases in use among male participants, and among those who used other substances more frequently. Finally, we explored whether changes in marijuana use frequency following legalization were related to cumulative frequency of use prior to 2018.

We recently described the relationship between marijuana and tobacco use in this sample (Doran et al., 2019) and there is partial overlap in the data used in these studies. The primary differences are (1) the previous study included data only from subjects' first two years following enrollment, while the current study utilized data from all three years of follow-up, regardless of when subjects enrolled, and (2) the previous study examined trends in use over time without regard to changes in the legal environment, while the current study explicitly examined whether frequency of marijuana use was associated with legalization of recreational sales.

Methods

Study Sample

We recruited California residents aged 18–24 who had smoked cigarettes at least monthly for 6 months but never daily for 30+ days. Participants were recruited on a rolling basis during 2015–2016 and completed substance use assessments quarterly for three years. The present secondary analysis utilized an "intent-to-treat" approach, in which all enrolled participants (n = 563) were included. Average age at enrollment was 20.4 years (SD=1.8), 51.9% were male, and most (61.1%) were full-time students. In terms of race/ethnicity, 41.7% identified as Caucasian, 21.0% Latinx, 19.1% Asian American, 13.1% multi-ethnic, and 5.1% from other backgrounds.

Procedure

Study participants completed assessments every three months for three years. All data were collected between March 2015 and October 2019. Assessments were completed online via SurveyMonkey. Compensation was $25 per annual assessment and up to $40 per quarterly assessment via electronic gift cards. Staff sent individualized survey links via email or SMS. All procedures were approved by the University of California, San Diego Institutional Review Board..

Measures

Demographics evaluated at baseline included sex, age, racial/ethnic background, and student status. Because the age range was narrow and our interest was in the potential impact of legalization, age was transformed into a time-varying binary variable reflecting whether or not participants were aged 21 at the time of each assessment. Student status was collapsed into a dichotomous variable comparing full-time students to all others. Marijuana and tobacco frequency were assessed at all 13 timepoints. At annual assessments, participants completed the Timeline Follow Back (L. C. Sobell & Sobell, 1992; M. B. Sobell, Sobell, Klajner, Pavan, & Basian, 1986), on which they reported number of cigarettes, and

whether they had used each of e-cigarettes, hookah, cigars, cigarillos, smokeless tobacco, snus, marijuana, and alcohol on each of the previous 14 days. At quarterly assessments, participants completed brief daily surveys, in which they indicated whether they had used each of the same products in the last 24 hours.

We created time-varying variables representing constructs of interest. *Time* reflected the study timepoint, from baseline (time = 0) to year 3 (time = 12). For all assessments, we calculated the number of days on which participants used marijuana (*marijuana frequency*), cigarettes (*cigarette frequency*), e-cigarettes (*e-cigarette frequency*), and alcohol (*alcohol frequency*). We counted the number of days at each timepoint at which assessment occurred (*days*) to account for the fact that the maximum number of days differed for annual (14) versus quarterly (9) assessments, and that participants may not have provided data for all days during quarterly assessments. We created a binary *legalization* variable that indicated whether or not each assessment occurred prior to or after January 1, 2018. We also created a *post-legalization slope* variable that was coded as 0 for all pre-legalization timepoints, and to reflect time since legalization for post-legalizatin timepoints (e.g., the first timepoint following legalization had *post-legalization slope* = 1, the second *post-legalization slope* = 2, and so on). Finally, for each participant we calculated the total number of days prior to January 1, 2018 on which use was assessed (*cumulative days*), as well as the number of those days on which any marijuana use was reported (*cumulative marijuana days*).

Statistical Analysis

We used bivariate tests to evaluate whether demographic variables were related to predictors and outcomes; when associations were significant, we accounted for demographics in hypothesis tests. To test whether frequency of marijuana use changed following legalization we utilized a piecewise or segmented multilevel longitudinal regression model, an approach recommended for evaluating the impact of policy changes (Lagarde, 2012). This model included segments for the period prior to January 1, 2018, and for the period from that date onward. The model tested the temporal trend in frequency of marijuana use, the impact of legalization, and changes in the rate of marijuana use over time following legalization by incorporating the *time, legalization,* and *post-legalization slope* variables as predictors. Sex, race/ethnicity, and binary age were included as covariates.

Second, we used multilevel longitudinal regression models to evaluate the associations of sex, race/ethnicity, binary age and frequency of alcohol, cigarette and e-cigarette use with frequency of marijuana use before and after legalization. We did so by testing for three-way interactions between the predictors of interest (e.g., age), *time*, and *legalization*. Significant three-way interactions would indicate that impact of legalization on the trajectory of marijuana use frequency was moderated by the predictor of interest. All demographic interaction terms were included in one model, and all substance use interaction terms in another. In both cases, non-significant interaction terms were removed in a backward manner (i.e., higher-order terms removed first) and models refit. Finally, we used a similar multilevel modeling approach to test whether time-invariant *cumulative marijuana days* was associated with time-varying *marijuana frequency* over time post-legalization. All analyses were conducted using Stata 15.0, with alpha = .05; missing data were not imputed.

Results

Preliminary Analayses

The proportion of data missing was 0% for the first 3 assessments (baseline and the next two quarters), and increased with each subsequent assessment, with 3.2% of participants missing outcome data at year 1, 10.5% at year 2, and 14.1% at the final year 3 timepoint. Missingness increased over time and was most common among participants identifying as White (*p*s < .01). Missingness was not significantly associated with sex or with frequency of cigarette, e-cigarette, or marijuana use at the previous assessment. The first 5 assesments (i.e., from baseline to year 1) occurred prior to legalization for all participants. The proportion of the sample for whom assessment occurred after legalization increased with each subsequent assessment, from 1.8% at the first quarterly timepoint following year 1, to 37.7% at year 2, 80.3% six months after year 2, and 100% at year 3. Bivariate analyses indicated women tended to use e-cigarettes less frequently ($p = .013$), younger participants used marijuana more frequently ($p = .003$), and non-White participants reported greater cigarette frequency ($p = .002$). Consequently, sex, age, and race/ethnicity were included in subsequent analyses.

Table 1 details frequency and likelihood of marijuana, alcohol and tobacco use at baseline and at each annual assessment. The proportion of days on which participants used marijuana remained relatively stable, while the number of participants who reported any marijuana use declined modestly from baseline to year 3. Alcohol use was stable across the three years of observation. Proportion of days using e-cigarettes exhibited a 50% increase, while the proportion of participants with any e-cigarette use was relatively stable. In contrast, use of cigarettes, and consequently overall use of tobacco products, decreased over time.

Post-Legalization Change in Marijuana Use

The piecewise regression model is shown in Table 2. Frequency of marijuana use was significantly associated with race/ethnicity and age, such that participants who identified as white and who were under age 21 at the time of assessment reported more days of marijuana use. The main effect of time was not significant, indicating that days of marijuana use was stable over 3 years of observation, consistent with the descriptive statistics in Table 1. The *post-legalization slope* term was also not significant, indicating that the trajectory of marijuana use for the post-legalization segment of the model did not differ from the overall trajectory.

Moderation by Demographic and Substance Use Variables

Table 3 shows the final model evaluating the impact of legalization on associations between demographic variables and frequency of marijuana use over time. We found that age and racial/ethnic identity continued to predict marijuana use frequency, but that the strength of those associations did not change over time or following legalization. In contrast, we found significant interactions of sex with both time and legalization. To better understand these interactions, we removed sex from the model and evaluated associations between time, legalization, and marijuana use frequency separately for men and women. These analyses indicated that marijuana use frequency generally decreased over time for male participants

($z = -2.80$, $p = .005$), but also increased nonsignificantly following legalization ($z = 1.82$, $p = .068$). In contrast, female participants reported increasing marijuana use frequency over time ($z = 3.00$, $p = .003$) overall, but with a non-signficant decrease after legalization ($z = -1.47$, $p = .142$). Examinatin of adjusted means suggested that, in both cases, the non-significant effect of legalization was a reflection of an initial post-legalization increase followed by a reversion to the previous trend of decreasing use over time for men and increasing use for women.

Table 4 shows the results of the model examining substance use predictors. There was a positive association between alcohol frequency and marijuana frequency, but this did not vary by time or after legalization. In contrast, we found that the associations between both cigarette frequency and e-cigarette frequency and marijuana frequency over time were moderated by legalization. To clarify these interactions, we removed legalization from the model and examined associations before and after legalization. These simple effects tests showed that, before legalization, there was a consistent positive association between cigarette and marijuana use frequencies that did not vary over time ($z = 5.12$, $p < .001$). However, this association declined over time following legalization ($z = -3.55$, $p < .001$). In contrast, the association between e-cigarette frequency and marijuana frequency was significant at baseline but declined over time prior to legalization ($z = -4.43$, $p < .001$). However, following legalization there was a consistent positive association betweent the two ($z = 3.28$, $p = .001$).

Finally, we evaluated the extent to which the total number of days of marijuana use prior to legalization predicted days of marijuana use after legalization, and if so whether this varied by time. Age, sex, and race were included as covariates but none were significantly associated with marijuana use after legalization in this model. We found a significant main effect ($z = 14.38$, $p < .001$) and interaction with time ($z = 3.75$, $p < .001$). The former indicates that those who reported more cumulative days of marijuana use prior to 2018 also reported more days of marijuana use at the first assessments they completed in 2018, while the latter indicates that this association grew stronger over subsequent observations.

Discussion

We set out to examine whether frequency of marijuana use changed following legalization of recreational sales in California. We also planned to test whether post-legalization trajectories of marijuana frequency would be associated with sex, age, race/ethnicity, alcohol or tobacco use, or pre-legalization marijuana frequency. We utilized a sample of young adults who were non- and never-daily cigarette smokers at the time of enrollment. This sample has multiple advantages compared with others that are available. Unlike most national datasets, we were able to evaluate change over time in a specific cohort. Additionally, assessment occurred at specific, quarterly intervals. Thus, in addition to providing more assessments within each year, it was possible to pinpoint each assessment to before or after changes in legal status. Additionally, the analytic approach allowed us to include participants who were enrolled at different points prior to legalization and thus had completed varying numbers of assessments at that point.

Contrary to our expectations, frequency of marijuana use did not change significantly after legalization, and was stable throughout three years of observation. Participants who were younger and who identified as White reported more days of marijuana use; these associations were consistent over time and did not change with legalization. Sex differences were also noted, with men reporting decreasing and women increasing marijuana use frequency over time, though this association was not significantly related to legalization. This difference is contrary to previous research suggesting greater use among men (Hasin et al., 2015), though more recent data suggest that this discrepancy is shrinking (Chapman et al., 2017). Our findings are consistent with evidence that use may escalate more quickly among women (Kerridge, Pickering, Chou, Saha, & Hasin, 2018). Women appear to be more sensitive to the rewarding effects of cannabis use (Matheson et al., 2020; Sanchis-Segura & Becker, 2016), and thus may be more vulnerable to increasing use after initiation and/or when barriers to use are reduced.

We also found that associations of both cigarette and e-cigarette frequency with marijuana frequency over time were moderated by legalization. More specifically, the association between marijuana and cigarette use became weaker following legalization, while the marijuana-e-cigarette assocation showed the opposite pattern. Frequency of alcohol consumption was consistently associated with marijuana use over time and did not change with legalization. Finally, we found that those who reported more frequent marijuana use prior to legalization tended to do the same afterward, particularly at later assessment points. Although frequency of of marijuana use was associated with both cigarette and e-cigarette use, the post-legalization findings suggest that co-use of e-cigarettes and marijuana may increase when the latter is legalized. One potential explanation for this could be that many young adults perceive vaping and marijuana use as conferring little risk (Roditis & Halpern-Felsher, 2016), in which case legalization may have removed an important barrier to use. In combination with the finding that marijuana use was more common among those under age 21, this suggests that enforcement of minimum age laws may be an important component of limiting use of both marijuana and e-cigarettes.

Our finding of no overall change in marijuana frequency is consistent with reports suggesting little impact of medical marijuana laws on use in California (Hasin et al., 2017). It is notable that we found that those who used marijuana more frequently prior to 2018 reported greater increases in use from 2018 onward. On one hand this is encouraging in that it suggests that lighter and non-users of marijuana were not necessarily encouraged to use as a result of legalization. On the other hand, it appears that those who were already more regular users may have tended to increase consumption, potentially increasing vulnerability to the risks associated with marijuana use.

In contrast to previous studies (Kerr et al., 2018), we found participants who endorsed greater frequency of marijuana use had greater frequency of use of tobacco products. Following legalization this was particularly true for e-cigarettes. The specific mechanism for this association is uncertain, but there are multiple possibilities. First, it may be that relaxing restrictions on a specific substance reduces substance-specific concerns about harm (Wadsworth & Hammond, 2019), which then generalizes to other drugs. Alternatively, the association can be explained by use of products that deliver both drugs at the same time

(e.g., blunts), or newer vaporizing devices that may do so separately. It is plausible that innovations in nicotine vaping devices encourages marijuana vaping, promoting diversified marijuana product use and synergistically increasing use of both products. This is consistent with the strengthening association between marijuana and e-cigarette use frequencies post-legalization. The association could also be a reflection of contextual or environmental influences (e.g., exposure to co-users, access to both substances). The possibility that lessening marijuana barriers increases tobacco use is concerning given evidence that co-use is associated with psychosocial distress (Peters, Schwartz, Wang, O'Grady, & Blanco, 2014; Ramo et al., 2012), health problems (E. Meier & Hatsukami, 2016), nicotine dependence (Agrawal et al., 2008), and tobacco cessation failure (Gray et al., 2017; Peters et al., 2014).

The present study has several limitations. It is a secondary analysis of a naturalistic study of young adult tobacco users, which limited the specificity of marijuana-related measures (i.e., we were unable to account for route of administration, THC content, and other potentially important variables) and may have yielded a sample with disproportionately frequent marijuana use. There is a strong need for additional studies that include outcomes beyond simply quantity, freuqency or prevalence of use (e.g., social/occupational impact) (Scheim et al., 2020). The design may limit generalizability to other young adult samples. Another limitation is reliance on self-reported substance use data, though evidence suggests self-report tends to be accurate in observational studies, given the lack of strong demand characteristics (Simons, Wills, Emery, & Marks, 2015). Additionally, self-reported data include only some days during 2015–2019 and may not be representative of use during the entirety of this period. Finally, while the study captured self-reported use of marijuana and nicotine/tobacco products before and after legalized sales of recreational marijuana began in California, we did not directly evaluate access to marijuana retail outlets or other methods of product acquisition.

Conclusions

In examining marijuana use before and after legalization of recreational sales in California, we found that frequency of use did not change significantly overall, including following legalization. We also found that increases in marijuana frequency tended to coincide with increased tobacco use, and a specific post-legalization association with e-cigarette use. Finally, we found that the most frequent users of marijuana after legalization were those who had used most often prior to 2018. Findings suggest loosening of marijuana restrictions could lead to negative health consequences for young adults. Strengths of the study include the sample size, and the repeated evaluation of a cohort of young adults before and after legalization. Further research is needed to confirm these findings, to understand how risks associated with changes in marijuana policy can be attenuated, and to identify surveillance targets. The continuously evolving marijuana and tobacco landscape also indicates the importance of ongoing evaluation of co-use.

Acknowledgements:

No financial disclosures were reported by the authors of this paper. All authors' work was supported by grant R01DA037217 from the National Institutes of Health. The study sponsor had no role in study design, data collection, analysis or interpretation, manuscript writing, or the decision to submit the report for publication.

Author Disclosure

Role of Funding Sources

The research was supported by National Institutes of Health grant R01 DA 037217 (ND). The funding agency played no role in terms of study design, data collection, analysis or interpretation, writing of the manuscript, or the decision to submit the manuscript for publication.

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Highlights

- Legal restrictions on marijuana use have decreased over time
- Little is known about the impact of legalization on use of marijuana or other substances.
- In a sample of young adults who used tobacco, frequency of marijuana use was stable over time and following recreational legalization.
- After legalization, frequency of marijuana use increased among those who had previously used most frequently, as well as among women and e-cigarette users.
- Systematic research into the impacts of legalization and use of multiple substances is warranted.

Table 1.

Frequency and likelihood of use of marijuana, alcohol, and tobacco products over time.

Product	Baseline	Year 1	Year 2	Year 3
	Proportion of days using, across participants			
Marijuana	27.8%	31.6%	29.6%	27.9%
Alcohol	35.3%	34.1%	35.8%	34.9%
Cigarettes	38.0%	35.1%	21.8%	16.9%
E-cigarettes	11.6%	10.7%	15.3%	17.3%
	Proportion of participants with 1 or more days of use			
Marijuana	58.6%	58.3%	57.3%	50.8%
Alcohol	91.6%	91.2%	90.9%	88.7%
Cigarettes	92.9%	84.4%	56.9%	46.3%
E-cigarettes	32.8%	23.7%	31.5%	36.2%

Table 2.

Piecewise longitudinal multi-level model of the frequency of marijuana use overall and following legalization.

Predictor	Coefficient	Std Error	z-score	p-value
Intercept	1.03	0.19	5.54	<.001
Days assessed	0.27	0.01	18.96	<.001
Time	0.02	0.02	0.70	.487
Sex (0 = male)	0.02	0.09	0.26	.795
Race (0 = White)	−0.51	0.05	−10.33	<.001
Age (0 = 18–21, 1 = 21+)	−0.64	0.11	−5.69	<.001
Legalization	0.04	0.20	0.20	.844
Post-legalization slope	0.01	0.06	0.20	.842

Table 3.

Longitudinal multi-level model of the frequency of marijuana use moderated by legalization and demographic predictors.

Predictor	Coefficient	Std Error	z-score	p-value
Intercept	1.03	0.18	5.57	<.001
Days assessed	0.27	0.01	19.12	<.001
Time	−0.08	0.03	−3.32	<.001
Race (0 = White)	−0.51	0.05	−10.35	<.001
Age (0 = 18–21, 1 = 21+)	−0.63	0.11	−5.58	<.001
Legalization	0.36	0.21	1.72	.086
Sex (0 = male)	−0.79	0.17	−4.60	<.001
Time * sex	0.17	0.03	4.94	<.001
Legalization * sex	−0.57	0.29	−2.01	.045

Table 4.

Longitudinal multi-level model of the frequency of marijuana use moderated by legalization and substance use predictors.

Predictor	Coefficient	Std Error	z-score	p-value
Intercept	0.68	0.20	3.47	.001
Days assessed	0.17	0.02	10.26	<.001
Time	0.08	0.02	3.13	.002
Race (0 = White)	−0.44	0.05	−8.83	<.001
Age (0 = 18–21, 1 = 21+)	−0.75	0.11	−6.79	<.001
Legalization	−0.06	0.19	−0.34	.731
Sex (0 = male)	0.11	0.09	1.21	.228
Cigarette days	0.14	0.03	5.24	<.001
E-cigarette days	0.18	0.03	5.50	<.001
Alcohol days	0.16	0.02	9.33	<.001
Legalization * cigarette days	0.59	0.17	3.40	.001
Time * cigarette days	0.01	0.01	0.99	.322
Legalization * time * cigarette days	−0.06	0.02	−3.82	<.001
Legalization * e-cigarette days	−0.23	0.16	−1.43	.154
Time * e-cigarette days	−0.03	0.01	−4.38	<.001
Legalization * time * e-cigarette days	0.04	0.02	2.36	.018